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Studying the Fatigue of Metals

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Inception of the investigation into fatigue of metals and means for conducting it—Testing machines and test specimens—Some of the more important conclusions already reached

IN 1918, there was organized under the joint auspices of the National Research Council, Engineering Foundation, and the Engineering Experiment Station of the University of Illinois an investigation of the phenomena connected with "fatigue" of metals under repeated stress. The necessity for such an investigation was emphasized by various problems arising in connection with the war. Since the early part of 1919, this investigation has been in active progress at the University of Illinois, and the co-operative group supporting it now includes in addition to the three parties named above, the General Electric Co., the Allis-Chalmers Manufacturing Co., the Western Electric Co. and the Copper and Brass Research Association.

The University of Illinois has provided for the laboratory of the investigation, 2,500 sq.ft. of floor space originally planned as a testing floor for airplane engines. The regular equipment of the materials testing laboratory of the University of Illinois is available for ordinary physical tests of the metals studied, the metallographic equipment of the division of Applied Chemistry of the university and the machine shop of the department of Theoretical and Applied Mechanics are available for auxiliary work.

The accompanying photographs, Figs. 1, 2 and 3, show the general arrangement of the special laboratory given over to this investigation. Detailed descriptions of the various machines are given in Bulletins 124, 136, and 142 of the Engineering Experiment Station of the University of Illinois. These bulletins may be obtained by anyone interested in the work, by application to the director of the station.

The outstanding work of the investigation has been the accumulation of a large amount of test data for long-time tests of metal under repeated stress. In getting these fundamental test data, the rotating-beam machines shown in Fig. 1, and diagrammatically in Fig. 4, have been the main reliance. These machines run day and night at 1,500 r.p.m., and subject specimens to cycles of reversed flexure. Dimensions of the specimen are shown in Fig. 5. It has been considered important to compare the results of these tests under reversed flexure with the results of tests under cycles of stress involving direct tension and direct compression. Four types of tension-compression machines have been designed in connection with the work of the investigation. They are shown in Figs. 1 and 2. A diagram of one of them appears in Fig. 6, the specimen in Fig. 7. It has also been considered important to make studies of fatigue under repeated shearing stress set up by torsion. This has been done by use of an Olsen-Foster testing machine and by use of a speical

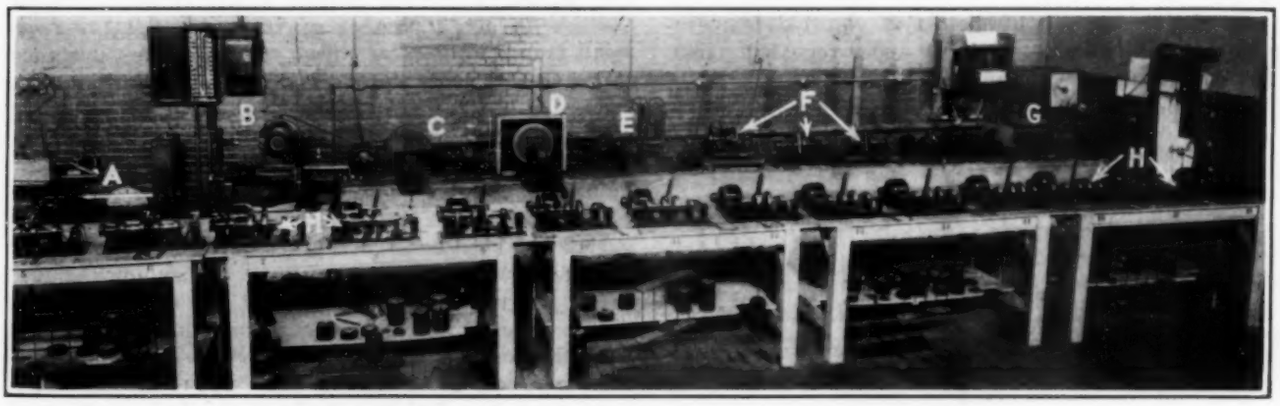


Fig. 1—East wall and southeast corner of laboratory

A—Illinois tension-compression machine. Model 4. B—Illinois tension-compression machine. Model 1. C—Illinois reversed torsion machine. D—Illinois tension-compression machine. Model 2. E—Double-hammer repeated impact machine. F—Illinois rotating spring fatigue testing machines. G—Rotating spring machines fitted with electric heaters. H—Rotating-beam "Farmer"-type machines for tests in reversed flexure.

Fig. 2—Southwest corner of laboratory

A—Illinois tension-compression machine. Model 3. B—Olsen-Foster repeated-torsion machine. C — Upton-Lewis repeated flexure machine. D—Testing machine for long continued steady load. E—Apparatus for determining fatigue limit by rise of temperature. Details are available in bulletins issued by the University of Illinois.

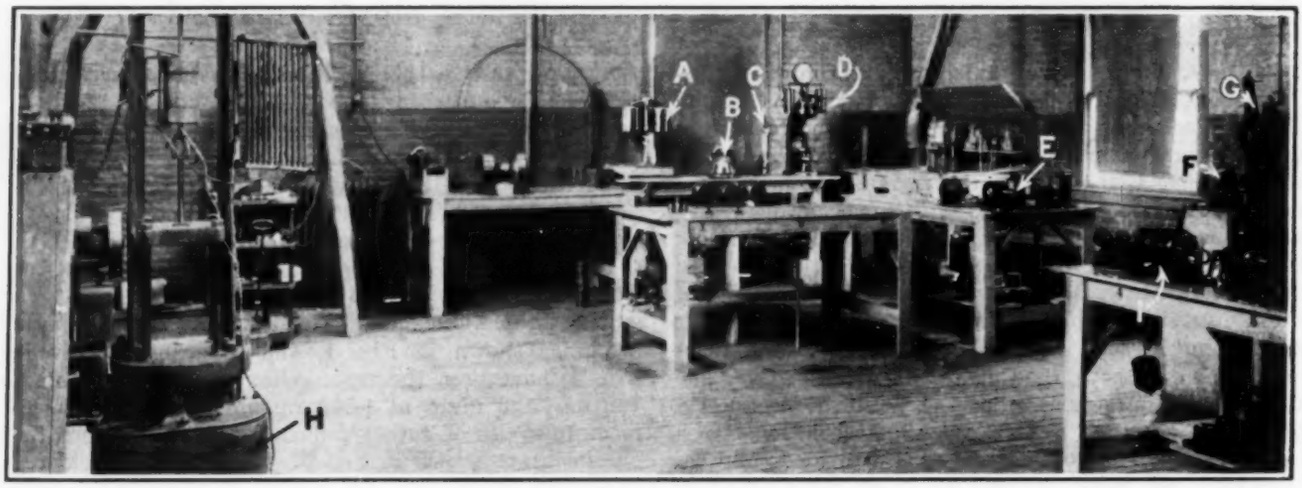


Fig. 3—Northeast corner of laboratory

A — "Baby" Brinell. B — Herbert hardness tester. C—Scleroscope. D—Brinell tester. E — Illinois repeated-flexure machines for thin, flat specimens. F — White-Souther rotating beam machine. G—Charpy impact machine. H—Olsen 10,000-lb. machine for tests at elevated temperatures. I—Rotating-beam "Farmer"-type machines.

machine designed in the laboratory and shown in Fig. 8. The specimen is shown in Fig. 9.

The effect of stress repeated but not completely reversed is also an important problem. It has been attacked with the aid of the rotating-spring type of machine shown in Fig. 1. A recent development is the study of the strength of metals at elevated temperatures both under steady load and under repeated stress. The apparatus for making this study is shown in Figs. 1 and 3. Already very interesting results for the fatigue strength of metal under temperatures up to 1,200 deg. F. have been obtained.

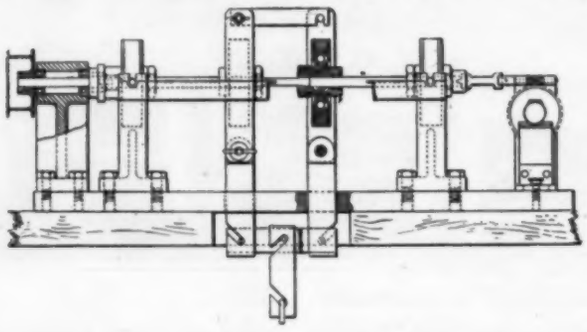


Fig. 4—Diagram of rotating-beam type testing machine for tests under reversed stress

Recent developments of the investigation have made it desirable to design a repeated-stress testing machine which can use very small specimens, so that in a structure which has been subjected to overstress it will be possible to get a number of fatigue specimens from small areas of the piece. Two such machines, designed in connection with the work of the investigation, are shown in Fig. 3. A number of auxiliary pieces of apparatus, developed or purchased to meet the need of the investigation, are also shown in the accompanying figures.

During the first three years of its work, the investigation has been concerned practically entirely with the fatigue of wrought ferrous metals. It has now included in its program a study of the fatigue of certain nonferrous metals, and already it has been found that the behavior of such metals under repeated stress differs markedly from that of the ferrous metals. It is very much hoped that a study of the fatigue strength of steel castings can be undertaken, although at present there are no funds for this special feature. The available knowledge of the fatigue properties of steel castings is very slight indeed.

The investigation is under the immediate charge of the Professor of Engineering Materials of the Illinois Engineering Experiment Station. In addition, its force includes an engineer of tests, four student helpers who

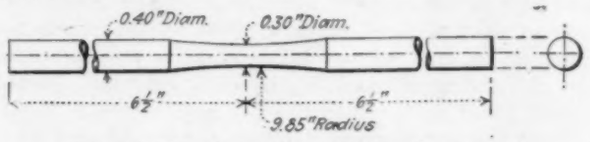


Fig. 5—Specimen for rotating-beam test (reversed bending)

have been especially trained for this work, two mechanicians, and a stenographer.

In the course of the investigation, some hundreds of tests have been run to one hundred million cycles of stress, a score or more of tests have been run through several hundred million cycles of stress and one test has been run through one billion cycles of stress. This last-named test required the continuous running of a rotating-beam testing machine for four hundred twenty-four-hour days.

Outstanding Conclusions from the Work of the Investigation of the Fatigue of Metals

1. The phenomenon known as "fatigue" of metals is really a progressive fracture of metals. A minute (probably sub-microscopic) crack is formed, the internal stress is intensified at the ends of the crack and

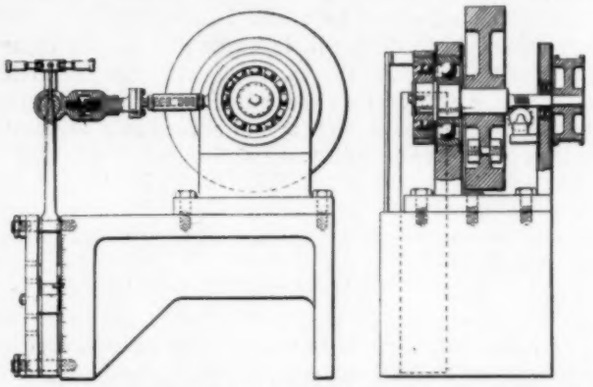


Fig. 6—Diagram of testing machine for reversed axial stress (tensional compression)

under successive applications of load the crack spreads like a minute hacksaw cut until there is not enough sound metal left in the cross-section of the piece to stand the load applied, and then failure occurs suddenly.

2. For wrought ferrous metals there is a limiting intensity of stress below which a metal is able to withstand an indefinitely large number of repetitions of stress without failure. This limiting stress is known as the *endurance limit* or the *fatigue limit*.

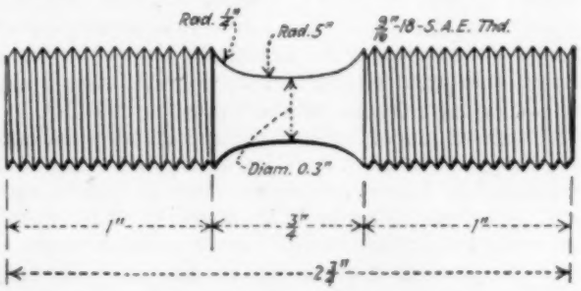


Fig. 7—Specimen for tests under reversed axial stress (tension-compression)

3. For wrought ferrous metals the endurance limit for cycles of completely reversed flexural or axial stress is about ⅔ the endurance limit for cycles of flexural or axial stress varying from zero to a maximum.

4. For wrought ferrous metals the endurance limit

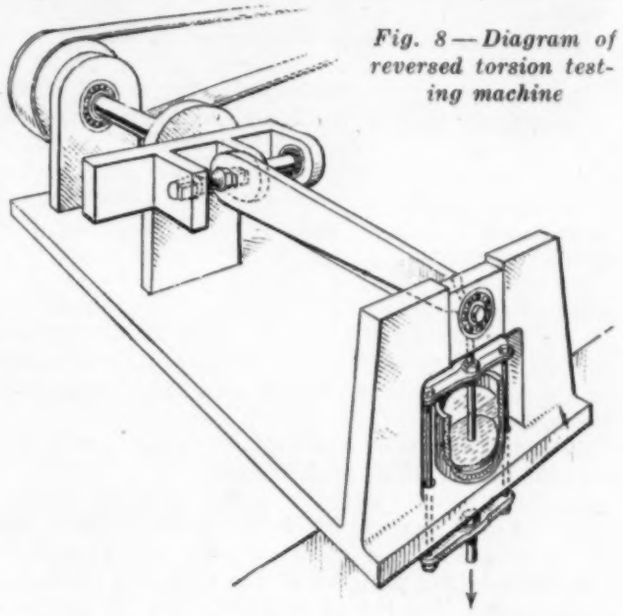


Fig. 8—Diagram of reversed torsion testing machine

for cycles of shearing stress is about 54 per cent of the endurance limit for similar cycles of flexural stress.

5. For wrought ferrous metals the endurance limit does not seem to be correlated to the ductility, or to the results of impact tests and it is very poorly correlated with the elastic limit (being usually below the elastic limit, but sometimes above it). It does seem to be correlated with the tensile strength and with the Brinell hardness number.

6. For the non-ferrous metals tested, the endurance limit is not nearly so clearly defined as it is for wrought ferrous metals. The ratio of endurance limit

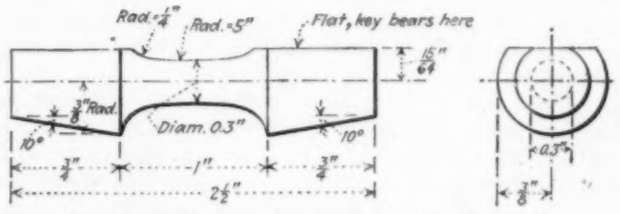


Fig. 9—Specimen for reversed torsion tests

to tensile strength is much lower for the non-ferrous metals tested than for wrought ferrous metals.

7. The ordinary formulas of mechanics of materials are based on assumptions of homogeneity of material and of regularity of stress-distribution throughout the material, and these assumptions imply a much simpler condition than actually exists in metals and other materials of construction. These assumptions give a picture of stress-distribution, however, which may be regarded as accurate in a general, statistical way. Even in the case of progressive failure under repeated stress the ordinary assumptions and formulas of mechanics of materials are found useful, though they cannot be regarded as rigidly true.

Setting and Maintaining Piece Rates

By Frank C. Hudson

BEFORE attempting to fix a time limit either for premium or piece prices, it is necessary to know the conditions prevailing in the particular shop in question.

If day work has always been in vogue, the only way is to make a study of the costs on various pieces as well as may be, from the records that exist. If the records simply give the number of machines turned out and the wages paid during that time, it would be better to postpone the introduction of the new plan for six months, and in the meantime make a study of the work in such detail as may seem necessary for that particular shop.

If, however, there are records enough to secure a fair idea of the cost of a certain unit of the machine, it may be best to make a price on such units until a time study can be made of the details. How careful a time study is necessary, depends on the shop and its product.

With a shop run by day work, probably seventy-five per cent of the time taken to produce a piece will be perfectly fair to the men, if assurance is given that the price will not be cut for a definite period, or until some radical change is made in the method of doing the work. With seventy-five per cent of the day-work price and the assurance that it will be maintained, the men will soon swing into a faster gait that will enable them to turn out more work and earn more money at the same time.

This makes a twenty-five per cent saving in the labor cost of the piece as well as giving a larger output for the same plant.

Upsetting Time Study Calculations

The question of time study is a wide one in itself, conditions determining how far it is economical to go in finding out the cost of every individual operation. There is no question that the only way to know that you are near to hardpan, is to study carefully each separate operation, such as drilling, milling, boring and not forgetting the handling of the work itself in and out of the machine. It often happens, however, that after we have set what seems to be the closest limit, a good workman, who couldn't figure a time limit to save his life, will cut the time in two by some combination of skill and hustle that is difficult to fathom and which no one else in the shop can possibly do. The human equation is the most difficult of all to figure on when it comes to setting time limits.

Before adopting any plan, it is necessary to determine whether we want low cost production or a low payroll. Some seem to think they must go together, but such is not the case.

It is better to understand at the beginning that no sane man, and if your men are not sane they are not the best men for your shop, will work any closer to his limit than necessary as long as he fears that it means a cut in time allowance or piece price. He fully realizes that an extra effort today means the necessity of that same extra effort every day if his extra day's work is taken as a standard, and no man always feels like working to the limit even for the extra pay.

It is extremely difficult to get away from the amount a man earns and look only at the cost per piece of his work, always including the lowered overhead charges due to the increased production from the same plant and the same supervision. But remembering that there must be a profit on every piece of work and every operation of that piece to make a profit on the whole machine, it becomes easier to see that a man who can turn out the most work is the cheapest man, even if he does count up large on the pay roll.

There are times when it becomes more than a question of reducing the cost per piece. When orders are behind, or capital tied up, it is worth money to increase the output of the plant a few per cent without putting up new buildings or adding to the machinery. An increase of ten per cent in the output of a $5,000 machine is worth several dollars a week in wages and should be borne in mind in setting time limits. In fact, one of the greatest values of any premium arrangement is the securing of co-operation of the men in devising ways and means for increasing the output.

Putting It Up to the Men

As an example let me cite a recent incident told me by a superintendent of a well known shop. He was behind on his drilling and secured permission from the manager to tell his men to go ahead without regard to how much they made. He assured them that the rate would not be cut no matter how much they made until such time as they came to him and agreed that it would be fair to do so.

When the men got to really believe what he said they started in to devise little kinks that helped things along and in a month they were earning nearly double their former rates. This continued for several months, when they finally came to him and agreed to a voluntary cut of twenty-five per cent.

I know this sounds like a fairy story, but I have his word for it and it is a word that I rely on fully. I am not sure as to whether the men are sprouting wings yet, or not.

But, in spite of the large payroll, the shop was getting the work for less money because it got more out of its machines, turned its product out sooner, secured its money on it, and reduced its overhead on the work.

While all this may have no direct bearing on the best way of setting rates, it does point out the fact that the actual rate is not the only point to be considered.

It is safe to assume that some of the rates set will be wrong, even after the best of time studies, and it is better to have them err in being too high rather than too low, since in any case they will be less than the former price paid for this work.

The main point in most cases is production and I do not believe it is possible to secure the most work from any man unless you can make him *see* and *know* that no rate will be cut without a mutual agreement, for a specified time at least, and that by the same token, rates may be raised if it can be honestly shown that they are too low, as some are bound to be.

The establishment of complete confidence of this kind, though not easy, can be accomplished in most cases and will, I am sure, increase the output of many shops from twenty-five to fifty per cent. With such a condition, the setting of the rate at first becomes of less importance than it might appear, since amicable adjustments can be made at any time. But this is only possible where the *net cost of the piece* instead of the *size of the payroll*, is the main consideration.

Heat-Treatment of Non-Corrosive Steels

By Joseph Kaye Wood
Consulting Engineer, New York City

The theory of corrosion—Chromium in the composition of stainless steels—Physical properties of non-corrosive steels—The trend for the future

MOST steels are unavoidably corrosive to an objectionable extent and represent a serious problem in the practical operation of many machines. The usual method employed to meet this problem is to replace those steel parts in danger of severe corrosion with similar parts made of suitable non-ferrous metals. Non-ferrous metals, however, are somewhat inferior to the steels in their important physical properties and in most cases are more expensive. The present trend is therefore towards the so-called stainless irons (low carbon steels) and steels which owe their resistance to corrosion chiefly to the presence of chromium in sufficient amounts.

Although the property which chromium possesses in making iron and steel immune to corrosion has been known for a number of years, the development and use of such alloyed metals has not been so extensive as that of the non-ferrous metals. Recent research, however, has made it possible to adopt some of the stainless steels for commercial use, although this does not mean that they are less expensive than non-ferrous metals at the present time. Nevertheless their superior physical properties remain as a big advantage, which must surely reduce the ultimate overall cost involved in the operation and maintenance of the machine in which they are used.

Corrosion Problems Vary with Locality

The geographical location of a machine makes a great difference as regards the conditions influencing corrosion. The average humidity in coastal cities and towns being much greater than in certain interior regions, machines and apparatus such as automatic telephone equipment will be more subject to corrosion in such places. Such equipment is particularly affected because the component parts are comparatively so small in cross section and control such small movements that proper functioning is impossible, or complete failure may result due to a decrease in mechanical strength. The writer's connection with the investigation and testing of such apparatus led to his suggestion of drawing up a map covering all territories wherein a manufacturer's product is liable to be used, which would show the average corrosive conditions to be expected in any given place. This information may be shown best by means of isolines, colored differently so as to give the average humidity and temperature, or their limits, both indoors and outdoors, inches or rainfall, and any destructive gases that would be prevalent. Peculiarly enough the non-ferrous metals are not always better than ordinary carbon steels from the corrosive standpoint, as for example the season-cracking of brass.

Iron is found in its native state combined chiefly with oxygen as ore and after the blast furnace operator has broken this union Nature proceeds slowly to reunite the two again. There are two principal methods by which the reunion is effected, the nature of the underlying force is assumed in both methods to be electromotive. If such then is the case the rate at which this reunion is affected or the acceleration of corrosion as it is usually called, depends upon the intensity of the electromotive force. The theoretical explanation of corrosion built upon this assumption is called the electrolytic theory, and is universally accepted as being

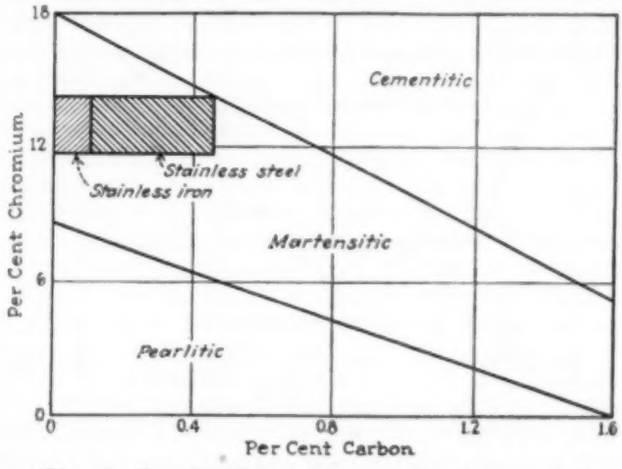


Fig. 1—Constitutional diagram of chrome steel

sound. Before going into the explanation of the two methods by which iron and oxygen are reunited it will be advantageous to briefly outline the electrolytic theory as given by the writer in an article, "Catalytic Action of Colloids in Corrosion" which was published in the July 30, 1923, issue of *Chemical and Metallurgical Engineering*.

Different atoms have different "sol" tensions, that is different tendencies to go into solution. Likewise similar atoms stressed differently have different "sol" tensions. Hence, in the case of iron, impurities such as carbides, and high local stresses due to the forming of iron or steel give rise to points of different electro potentials. The "sol" tension is greater at certain points on the same piece with the result that galvanic currents are set up and cause corrosion. Corrosion takes place at the high potential points while the hydrogen (plus) irons are attracted to the less positive parts where they form a protective film of hydrogen.

According to this theory absolutely pure and unstressed iron should not corrode. But where, outside

of the chemically prepared product or the famous wrought iron column in India, do we have such iron? Furthermore, corrosion is self accelerating, because its product is electronegative to iron. The objections to this theory have arisen because of the fact that with the introduction of certain physical and chemical phenomena the fundamental laws of corrosion were obscured. The colloidal theory, which should be considered as supplementary, weeded many of the obscuring phenomena out, revealing the important fact that the electrolytic theory was still fundamentally sound.

The two conditions which regulate the rate of corrosion of iron or ordinary steel, presupposing an excess of oxygen and freedom from conflicting physical phenomena, are as follows:

1—Degree of heterogenity due to the presence of additional constituents, principally carbon.

2—Stressed condition of iron or steel.

By freedom from conflicting physical phenomena is meant a condition such as may be observed in idle and in much used railroad rails. When wheels are constantly rolling over them the products of initial corrosion are physically swept away and since, as pointed out previously, rust itself is a great accelerator of further corrosion, the rate is deterred considerably. On the other hand, if the rails remain idle for a long time, the initial rust is undisturbed and further corrosion is promoted. There are many such conditions, both physical and chemical in nature, which affect the rate of corrosion, and a complete survey of actual conditions should always be made before attempting to draw any conclusions. It is hard to understand, unless on physiological grounds, why so many engineers even in large industrial concerns, will simply put a section of apparatus in a humidity tank for a few days and nights and be content with the result without considering the relation which the functioning of the apparatus would have to the corrosion of the materials.

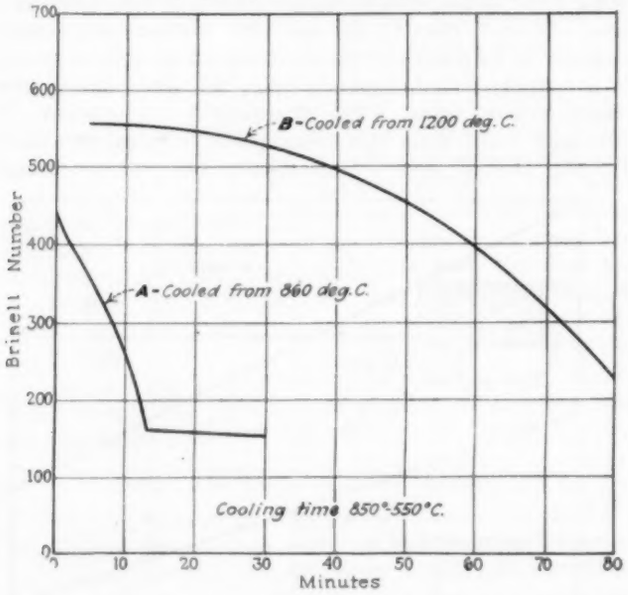


Fig. 2—Influence of cooling rate on Brinell hardness

Function of Chromium in Iron and Steel

In considering the effect of additional alloying constituents on corrosion we find that nature provides a third condition affecting the union of iron and oxygen. The element chromium by forming a solid solution with iron decreases the "sol" tension or tendency to go into solution in water. Sufficient chromium in solid solution will decrease the solubility of the iron in water to practically zero. Not all, however, of the total chromium content in iron or steel is in solid solution, as some of it is locked up in the carbides. The higher the carbon content the greater the amount of chromium that is locked up in the carbides, and hence the higher the solubility of the iron for a given total chromium content. Heat treatment of such a steel results in a fine martensitic structure, which means fewer carbides and more of the total chromium in solid solution. This increases the resistance to corrosion in two ways, first by decreasing the solubility of the solid solution matrix and second by increasing the homogenity due to fewer carbides which are electronegative to iron.

Difference Between Stainless Iron and Stainless Steel

The very simplest way to describe this difference is that stainless iron is a very low carbon (0.1 per cent or less) stainless steel. Stainless steel however is commercially understood to have the following composition:

Chromium —11 to 14 per cent.
Carbon —0.25 to 0.5 per cent.
Remainder—iron, special metal such as nickel, silicon, etc., and the usual impurities, sulphur and phosphorus.

Stainless steel has been known for a great many years, while stainless iron, so called, has only been produced commercially since about 1920 in the Brown Bayley's Steel Works of England. Up to this time the alloy of chromium that was added to iron contained about one per cent of carbon which in conjunction with the 60 per cent chromium content made the production of a low-carbon stainless steel having less than 0.25 per cent carbon impossible. The firm previously mentioned succeeded in 1920 however in reducing the ultimate carbon content because of the advent of a carbonless ferrochromium on a commercial scale. Hereafter only the term stainless steel shall be used and then in its broadest sense, that is, it shall be considered as applying to steel containing any per cent of carbon and about 11 to 14 per cent chromium.

The addition of chromium to steel causes the eutectoid point to occur at a lower per cent of carbon; thus for no chromium the eutectoid point occurs at 0.85 per cent carbon, for 2.0 per cent chromium it occurs at 0.66 per cent carbon, for 4.0 per cent chromium at 0.56 per cent carbon, for 8.0 per cent chromium at 0.43 per cent carbon, for 12.0 per cent chromium at 0.31 per cent carbon. From this we can see that carbon is needed to a very much less extent towards producing the various structural changes in steel as the chromium content increases. That is the carbon is restricted to about a maximum of 0.5 per cent in chromium or stainless steels as against 1.5 per cent in ordinary carbon steels. This replacement function of chromium for carbon, so far as microscopic structure is concerned is explained by means of Guillet's constitutional diagram for chrome steel shown in Fig. 1. The writer has cross hatched that portion of the diagram which outlines the stainless steel ranges in carbon and chromium and it will be noted that such steels are pearlitic after slow cooling and martensitic after heat treatment, quench or air cooling. Martensitic structure is the proper structure to use for maximum resistance to corrosion, particularly when it is reheated to a very high temperature to

dissolve all free particles of carbide. According to Bain freshly quenched martensite is only a transient condition of extremely distorted and fine-grained ferrite grains, while refined martensite is an extremely fine-grained alpha iron, containing some free particles of carbide, but not larger than the critical size in extent.

Heat Treatment of Stainless Steel (and Iron)

The critical or *Ac.* point for eutectoid composition of stainless steel (0.3 per cent carbon) is about 800 deg. C. as against 700 deg. C. for the critical point of the eutectoid composition of ordinary carbon steel, (0.85 per cent carbon). In ordinary carbon steel the carbide goes immediately into solid solution upon being heated to just above the critical point; in fact in the hardening of such a steel one is cautioned not to heat much beyond that point so as to avoid large grain growth.

With stainless steel however the chromium causes a considerable lag in the absorption of the carbides once the *Ac.* point has been reached. In heat treating or hardening this necessitates raising the maximum temperature about 200 deg. C. or heating up to 1,000 deg. C. When quenched from this temperature all free or visible carbides are eliminated and a pure martensitic structure results, which is the type of structure having the maximum resistance to corrosion.

The Brinell number of this steel is about 500 as against 600 for the corresponding pure martensitic structure in ordinary carbon steel (tool steel). The structure or hardness produced seems to be dependent upon the two factors of quenching temperature and time or rate of cooling. Portevin and Garvin have shown (July Iron and Steel Inst. 1919, 1,469) from experiments with ordinary carbon steel that it requires about 10 sec. in cooling from 700 deg. C. to 200 deg. C. to harden such a steel. Stainless steels on the other hand require a much slower rate, but if the quenching temperature is increased, which can be done without harmful effects with this steel, the cooling rate may be increased.

Monypenny in the November, 1923 issue of *Mining and Metallurgical Engineers' Journal* shows the influence of cooling rate on the Brinell hardness of stainless steel when cooled from both 860 deg. C. and 1,200 deg. C. His curves giving this data are reproduced in Fig. 2. In his paper he states, "there is a fairly definite rate of cooling that must be exceeded to bring about hardening; the rate, however, varies, in any given steel, with the temperature from which the steel is cooled. The higher this temperature is above the *Ac.* point, the lower is the rate at which the steel may be cooled and yet be hardened."

This is illustrated in Fig. 2 which represents the Brinell hardness numbers obtained on samples of stainless steel of approximately eutectoid composition when cooled at different rates from 860 deg. C. and from 1,200 deg. C., the rate of cooling being measured by the time taken to cool over the range 850 deg. C. to 550 deg. C. To obtain a Brinell hardness number of at least 400, the cooling time should not exceed about 2 min., when cooled from 860 deg. C. but may reach 60 minutes when the maximum temperature is 1,200 deg. C.

With slower rates of cooling than these, the steels become progressively softer until the completely annealed condition is attained. If the maximum temperature has been sufficiently high to dissolve all the carbide on complete annealing a pearlitic structure is obtained. If, however, the whole of the carbide was not dissolved, the structure is granular, being similar to that produced on hardening and fully tempering, except that the granules of carbide are much coarser. In either case the steel has a tensile strength of about 89,600 lb. per sq.in. and is properly described as being in the annealed condition. It will be obvious from what has been said that if it is necessary to anneal the steel for any particular purpose, the temperature of annealing should exceed the *Ac.* point by as small a margin as possible in order that the cooling period may not be unduly prolonged in obtaining the maximum softness. The same authority has the following to say in regard to the hardening:

"The greatest resistance will be obtained by quenching from a temperature sufficiently high to dissolve all the carbide in the steel. In practice, however, it is found that with a temperature of 900 deg. C. to 950 deg. C. the ground mass produced on quenching a steel of normal composition is practically insoluble in water and that increasing the temperature beyond this range produces no marked improvements, on the other hand it seriously increases the risk of cracking during hardening."

Constant Hardness During Tempering

There is nothing very unusual in the tempering of stainless steel except that no change in hardness occurs until 500 deg. C. has been reached. The Brinell number remains at about 500 up to 500 deg. C. after which it drops suddenly to about 300 at 600 deg. C. According to Monypenny the martensite, meanwhile is replaced by very fine sorbite or troostite, consisting of very fine particles of carbide, almost ultramicroscopic, embedded in a ground mass of ferrite.

The advantage of the constancy in hardness during a tempering range up to 500 deg. C. is that it permits the relieving of internal stresses due to hardening without decreasing the physical properties of the metal or its resistance to corrosion. The latter is due of course to the fact that no carbide particles are precipitated, which as we have pointed out earlier are the cause of high potential points on the surface of the metal. With higher tempering, up to 600 deg. C., there is a marked decrease in the stainless property of the metal accompanied by a decrease in the physical properties. The final condition of a hardened stainless steel is adjusted by tempering between 600 deg. C. and 700 deg. C. in which range the change in hardness, although sufficient for practical purposes, is not too sensitive.

The low carbon stainless steels (stainless iron, less than 0.1 per cent carbon) have certain advantages over the higher carbon type (0.3 per cent carbon). Although the hardness is limited to about 380 Brinell in the former type as compared with 550 Brinell in the latter type the former is much safer to heat treat. Stainless iron is much easier to machine and is more resistant to corrosion since, due to its low carbon content, it is much less affected by varying heat treatment than the higher-carbon type. That is, its resistance to corrosion is greatly increased over that of the higher-carbon type because it has a smaller amount of chromium locked up in the carbides.

A comparison of the physical properties of the British stainless iron and stainless steel are as follows:

	Tensile strength	Yield point	Elongation	Reduction of area
Stainless Iron...	150,000	135,000	13	42
Stainless Steel...	195,000	160,000	11	30

In this country the carbon content in stainless steel is usually run up a little higher, namely to about 0.60

for about the same range of chromium, 12 to 14 per cent. This steel is hardened in oil from 1,000 deg. C. and tempered to about 250 deg. C. which results in the following maximum physical properties:

Tensile strength	Yield point	Elongation	Reduction of area
205,000	100,000	9.0	25.0

Other Non-Corrosive Steels

The so-called stainless steels contain from 12 to 14 per cent chromium, but rustless steels may also be produced by reducing the chromium content to say 7 per cent and adding 3 per cent nickel and 3 per cent silicon. On the other hand, the chromium content can be increased to about 20 per cent but without materially enhancing its resistance to corrosion. Adding nickel to the extent of about 16 per cent and chromium to about 15 per cent with 0.24 per cent carbon produces a very good non-corrosive steel, but one which is rather difficult to machine. It is hardened at 1,200 deg. F., its critical range being greatly depressed. The physical properties of this steel are as follows:

Tensile strength	Yield point	Reduction of area	Elongation
130,000	100,000	35	25

A similar steel with 5 per cent more nickel and hardened at 1,425 deg. F. gives the following physical properties:

Tensile strength	Yield point	Reduction of area	Elongation
130,000	75,000	35	35

This steel is somewhat easier to machine.

According to Armstrong the general trend at this time is that the rustless irons of the future, if the chromium-alloy type is adhered to, will contain about 17 per cent chromium and an added element with iron. The added element may be silicon, nickel, molybdenum, or various others, all of which serve a very useful purpose. Silicon aids in the workability of chromium steels while molybdenum, having the opposite effect, greatly enhances the acid-resisting properties. Nickel, as stated previously, gives rise to machining difficulties due to the formation of normal austenitic structure resulting from its air hardening property.

Care in Grinding Drills

There are a number of theories as to grinding drills. Nearly all of the drill makers grind them by hand and it is amazing how skillful men become in this work. The eye becomes trained to detect very slight variations in the length of the two lips.

With either carbon or high-speed drills, great care must be observed as to lubrication. In grinding carbon drills, the drills must not get hot enough to draw the temper, and a good supply of water is necessary. With high-speed drills, however, it seems to be the rule to grind them dry on a free-cutting wheel. It is surprising to see the amount of metal that an expert drill grinder will remove in 15 sec. and not overheat the drill.

Drill makers advise against the use of water in grinding because a little water, like a little knowledge, is a dangerous thing. Too little water is apt to cause "checks" or small cracks at the point, and it is next to impossible to get water enough, when grinding high-speed drills as it is done in the factories. They should either be flooded or ground dry and, as it is difficult to get an adequate supply of water at just the right spot, it is safer not to use any.

A Reverse Curve Formula

By Hubert G. Smith

Recently I was confronted with the problem of making a reverse curve to connect two parallel lines using a certain distance along their length for the curve. While it presented no difficulty to construct this geometrically, I could not discover any ready-made formula to figure the radii.

After working out this formula it occurred to me that it might be interesting to others, and so I have set it down as follows:

Given two straight parallel lines *AB* and *CD* at a distance *N* from each other, it is required to connect

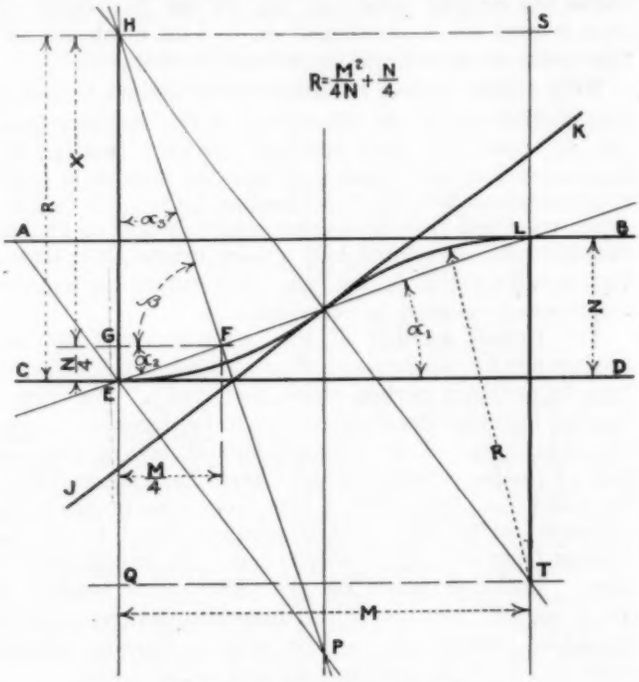


Fig. 1—The curve layout

them by a reverse curve, that will also be tangent to the line *JK* and that will have its centers on the verticals *HQ* and *ST* at a distance *M* from each other. To find *R*, the radius, is the problem.

Draw the diagonal *EL* and bisect it.

The center of the curve will be at the intersection of the perpendicular bisector of half of *EL* and the vertical *HQ*, which is at point *H*.

$$EF = \frac{EL}{4}, \text{ therefore } GF = \frac{M}{4} \text{ and } GE = \frac{N}{4}$$

$a_1 = a_2$, being alternate internal angles of parallels. $a_2 = a_3$ both being complementary to *B*.

Triangles *EFG* and *FHG* are similar, having equal angles,

Therefore $HG : GF :: GF : GE$

and $X : \frac{M}{4} :: \frac{M}{4} : \frac{N}{4}$. (The product of the means equals the product of the extremes).

$$\text{So } X \times \frac{N}{4} = \frac{M^2}{16}.$$

$$\text{Solving for } X,\ X = \frac{M^2}{16} \times \frac{4}{N} = \frac{M^2}{4N}.$$

$$\text{Since } X + \frac{N}{4} = R, \text{ then } R = \frac{M^2}{4N} + \frac{N}{4}.$$

Automotive Production

Some Problems Solved in Manufacturing the Hupp Eight—II

By John Younger
Associate Editor, *American Machinist*

Milling, boring and drilling the crankcase—Complete sequence of operations on the connecting rod—Babbitting the rod—Special multiple-station fixture for continuous work

IN A previous article an outline of the equipment available and policy adopted for manufacturing the Hupp Motor Car Corporation's straight-eight engine was given. We come now to the manufacture of the aluminum parts of the engine. Aluminum alloy is used for the crankcase and duralumin or S-17 for the connecting rod. Sometimes, as in the case of the crankcase, the cutting is done without lubricant, but the duralumin rods are lubricated with a soda oil compound.

The first operation is shown in Fig. 15 where the Ingersoll milling machine mills the bottom flange and front and rear support pads, and roughs and finishes the bearing caps. The front mechanism of the machine does one set of operations and the rear the remainder. The cases are then loaded on another Ingersoll where the top and both ends are rough milled. The large cutter, 31 in. in diameter with 65 teeth, as shown in Fig. 16 is well worth notice. Thence the case passes through a series of drilling operations on Baush multiple-spindle drilling equipment, Fig. 17. In connection with the trackway there is a transveyor at each end for the fixture that has just finished its work to cross over to a backtrack and be reloaded and start again on its journey. The trunnions on which the fixture revolves will also be noted together with the battery of special drills and taps that are held in the various spindles.

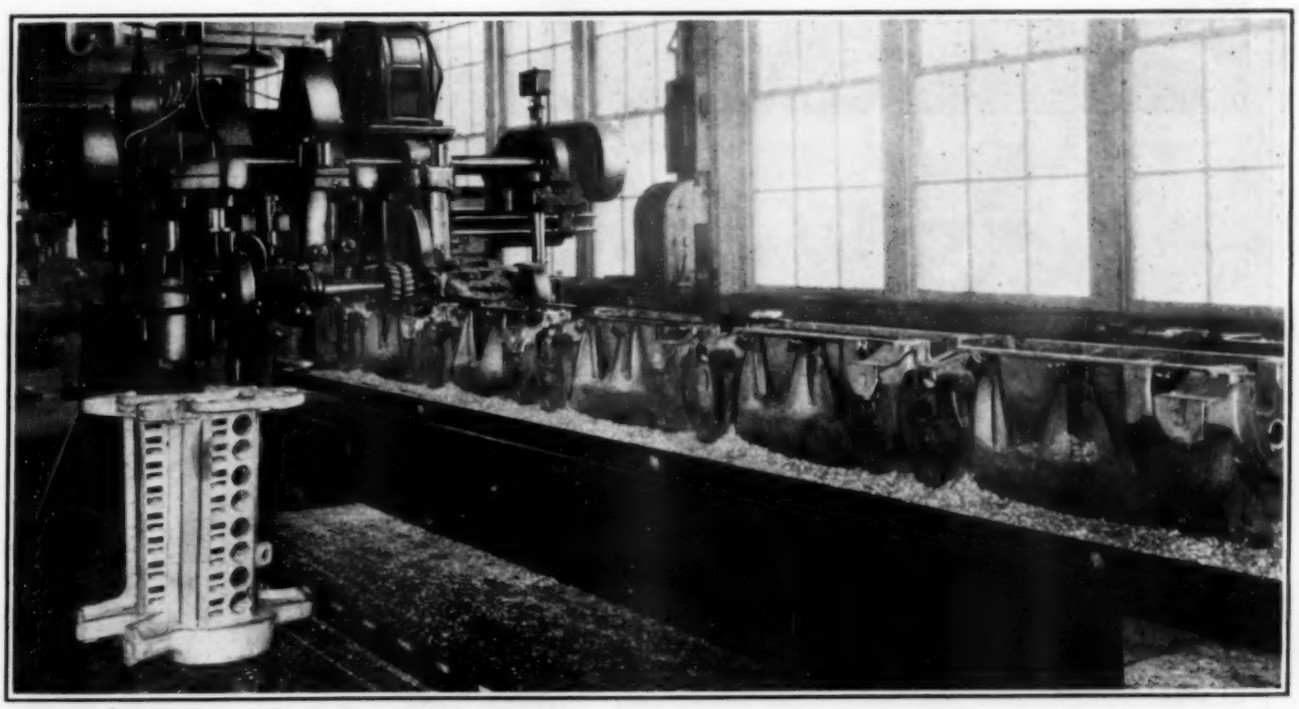
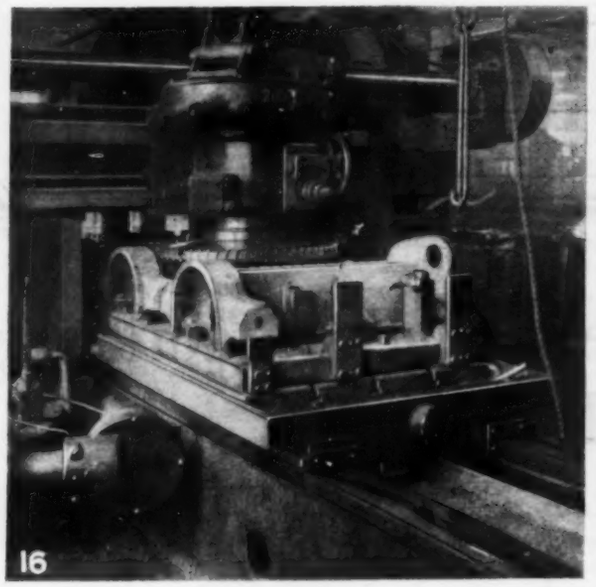
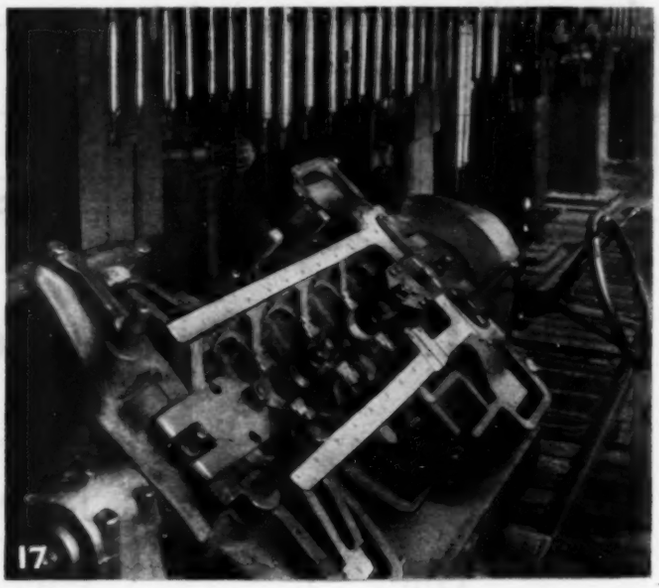


Fig. 15—String milling of crankcases in an Ingersoll machine





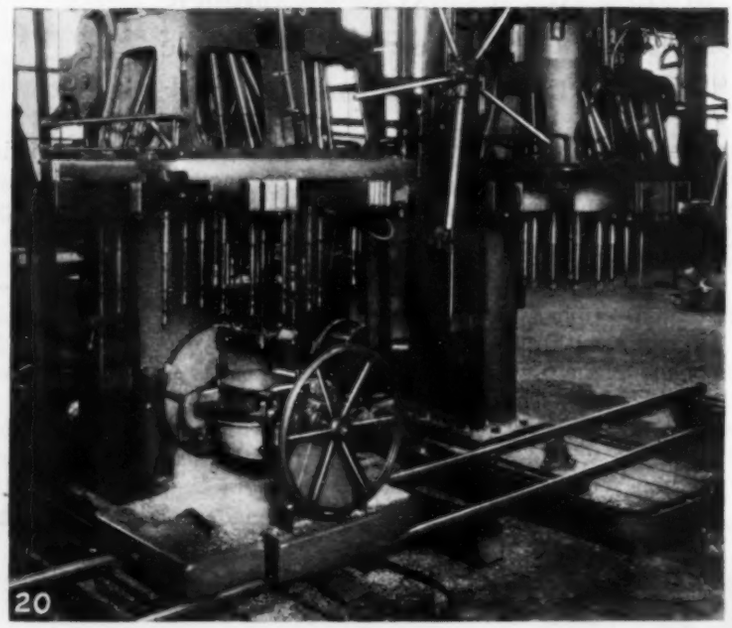


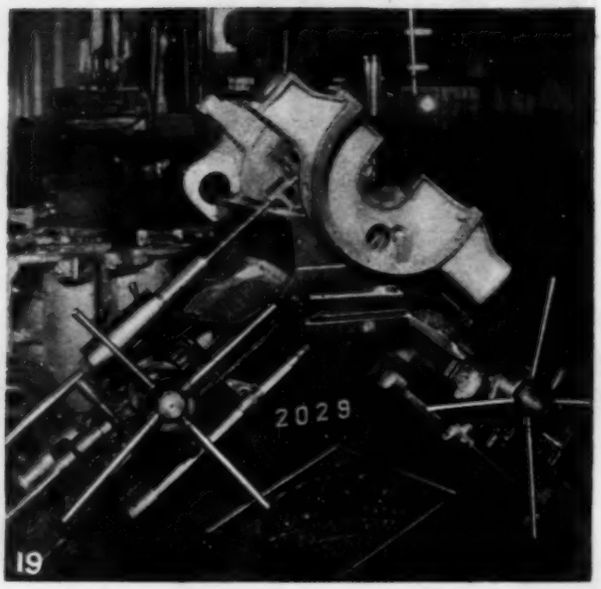
Fig. 16—A 65-tooth cutter at work

Fig. 17—The crankcase drilling line

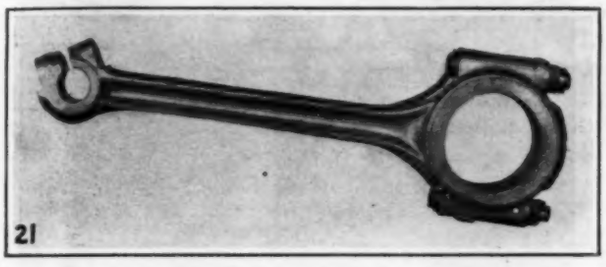
Fig. 18—A crankcase boring operation

Fig. 19—Drilling crankcase oil holes

Fig. 20—Five operations, two machines, one jig



AUTOMOTIVE PRODUCTION



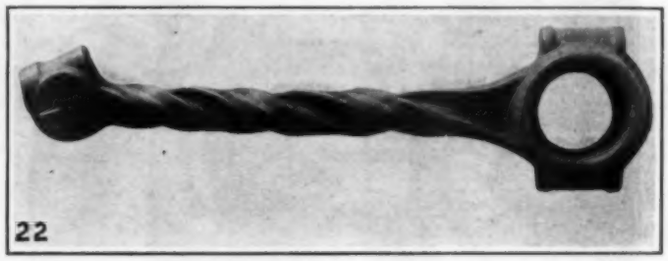


Fig. 21—The Hupp duralumin rod. Fig. 22—What can be done to the rod

The case is then rough bored and finally finish bored in a Rockford boring machine as shown in Fig. 18. Various cutters are shown in the illustration as is also the method of fastening down the crankcase with heavy swinging arms. These boring operations take place before the bushings are put in place, and there is naturally a final reaming operation by hand on the assembly floor. This brings us to the last operation on the case, as shown in Fig. 19; the drilling of the oil head holes on the Rockford special drilling machine. This is an interesting example of a specialized tool.

The track system for two multiple-spindle drills, as shown in Fig. 20, has been inserted here because it illustrates the manufacturing principle on which the Hupp Motor Car Corporation works. The particular subject is a flywheel housing and it is started under the first series of drills on the first drill press. When they have completed their work it goes to the second series on the same machine. There are actually five separate drilling operations on this piece of work in the two machines and the one fixture with the track device for transporting the fixture. One man takes care of all the work involved.

It is well worth while to study the work on the connecting rod in some detail. The rod is shown in a semi-finished state in Fig. 21. It is a duralumin drop forging and its strength can be estimated by the punishment it took to reach the condition shown in Fig. 22. First of all, the rods are drilled at the large and small ends as in Fig. 23, a Baker H. D. camfeed drill being used. Then the rod is clamped down in a fixture as shown in Fig. 24 and the large hole elongated so as to take care of the metal removed when the cap is slit off. This is done in a No. 2 Colburn drill press.

The large end of the rod is now babbitted in a special unit, Fig. 25, arranged right in the machining line. Babbitt is poured into the rod on the centrifugal machine shown on the left of the illustration. The thermocouples can be seen dipping into the babbitt pots. The temperature control is by the Hoskins system. The rods are then rough bored at the big end in a No. 2 Colburn drill press using the fixture shown in Fig. 26 and from here they go to a No. 13 Natco drill where the bolt holes in the big end are drilled and reamed. This operation, Fig. 27, is worth considering a moment. The fixture is a three-armed affair with the arms 120 deg. apart. The arm in the foreground is used for loading and unloading, the next for drilling and the third for tapping.

The big end is then straddle-milled in the fixture shown in Fig. 28. This fixture is also mounted on ball bearings. In it the rods are faced on both bolt-hole

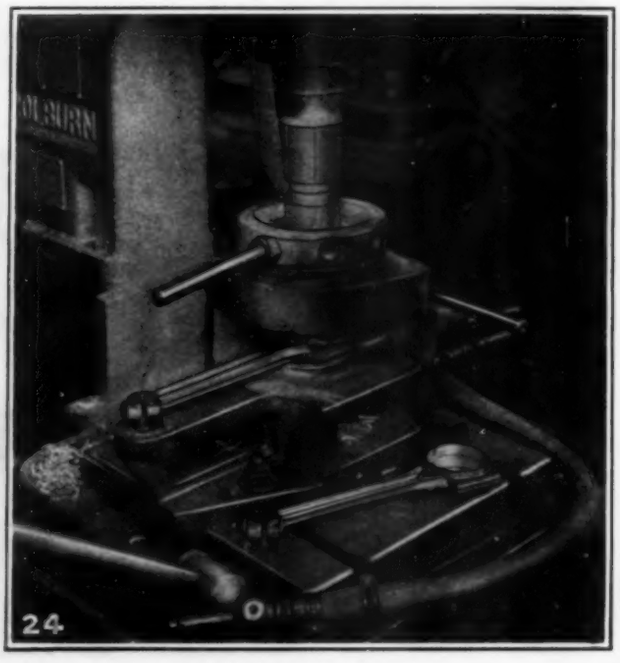
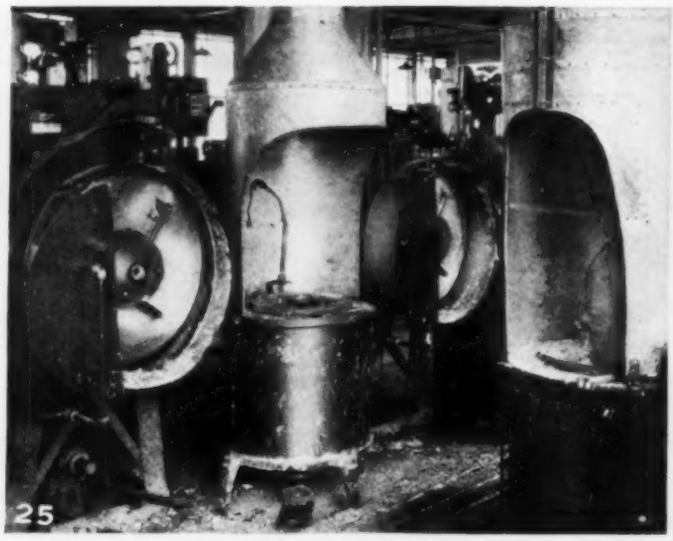
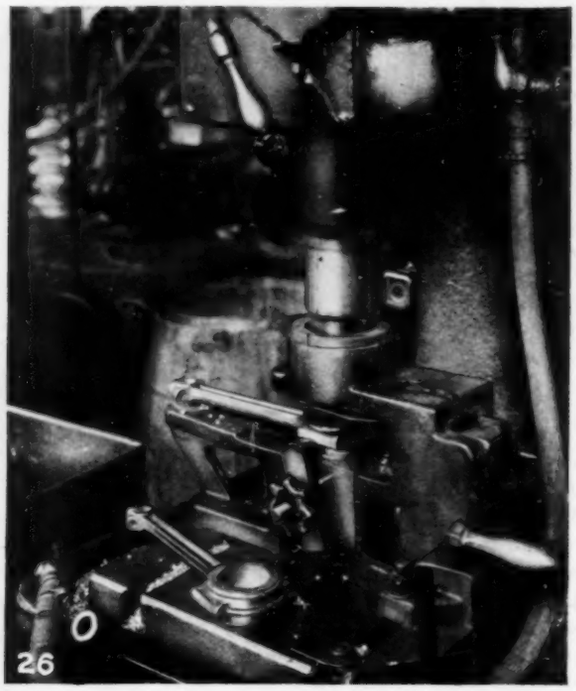


Fig. 23—drilling the connecting rod. Fig. 24—"Ovaling" the big end





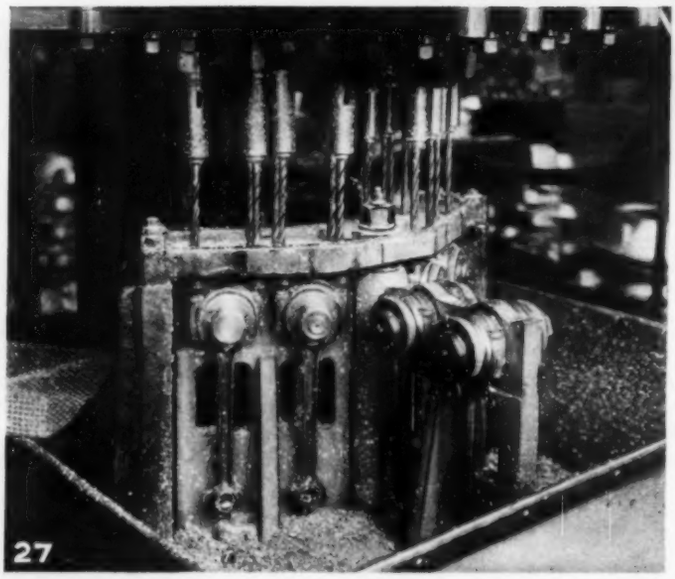


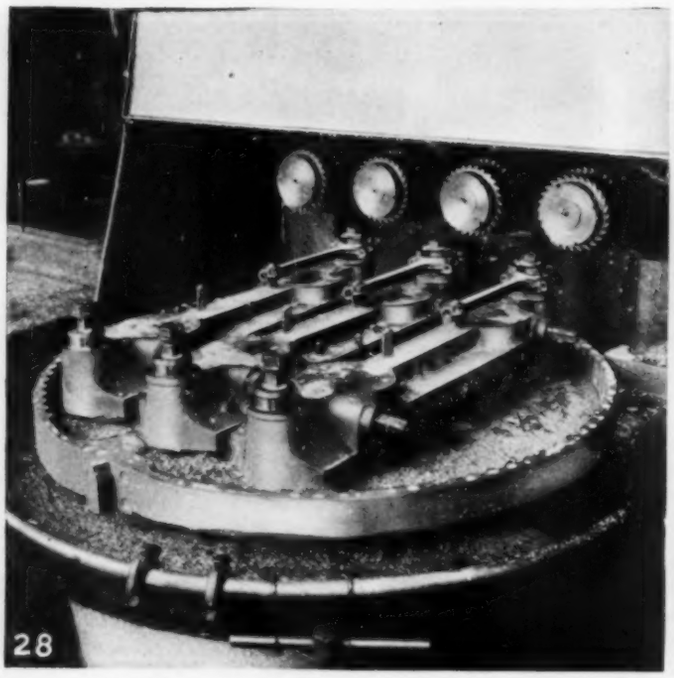
Fig. 25—The babbitting unit

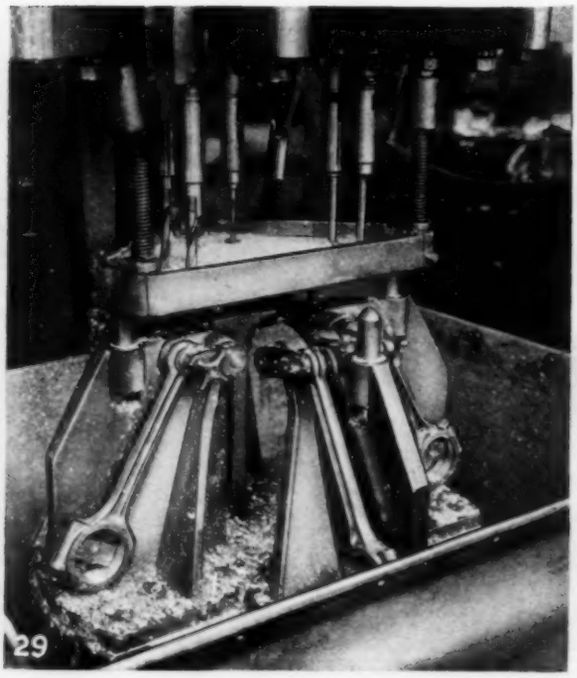
Fig. 26—Rough boring

Fig. 27—Machining cap holes

Fig. 28—Slitting and facing

Fig. 29—Drilling the small end





AUTOMOTIVE PRODUCTION

ends and have the caps slit off at the same time. The locking or locating fixture is clearly shown also. This operation is done on a C-76 Newton milling machine. Finally, the small clamping bolt hole at the small or wrist pin end is drilled and reamed in a rotary fixture as shown in Fig. 29. This is still another example of a ball bearing fixture, and the method of housing in the work to prevent chips and lubricant being scattered about will also prove of interest.

Abstracts

from other publications

Trend of Bus Design

R. E. Plimpton considers the developments that have taken place during 1924 and also the future progress of the bus. Outstanding among the features last year was the adoption of a six-wheel chassis by the Detroit Motor Bus Co. which now has nearly fifty in service, and also the plan of the Mitten company of Philadelphia to install two hundred gasoline-electric vehicles as part of the traction properties in Philadelphia and Buffalo.

Last year saw the increased use of the large double-deck bus seating up to seventy—this, however, seems to be the capacity limit. There was also an increase in comfort provided for passengers—pneumatic tires were installed on the Los Angeles double deckers last spring, and other companies have followed the example. Closed tops in general have added to the comfort of the upper deck passengers and there is a tendency toward better seats with softer springs and leather covering in place of the rattan construction.

There is also a tendency toward heavier single deckers with room provided for standees and in the intercity types, the so-called "aisle" sedan, is rapidly taking the place of the once popular multiple-door construction.

Parlor car or Deluxe types are in the ascendency even for regular service on common carrier routes. Individual chairs, a limited overhang of the body back of the rear axle, greater power from six-cylinder engines show which way design is tending. The six-cylinder engine is gaining a definite place in hard city work where double deckers must keep up high schedule of speed under traffic difficulties.

Governors are being considered by some, others will have nothing to do with them. Many vehicles are installing oil-filtering systems and many also are installing air filters; improvements in the electrical systems have given an impetus to battery ignition, although the magneto is still in the lead. There are operators however, who believe that the battery is the coming thing and that it will give less trouble in the ignition system.

Efforts are being continued to lessen gear noises, one chassis during 1924 was fitted with a "constant-mesh" transmission. Spiral bevel gear axles are coming in for medium size jobs, but the worm gear axle is far in the lead for the heavier types.

There has been a decided tendency toward metal wheels, either steel disk or cast aluminum and front wheel brakes were installed on several new designs, although there is some doubt among the operating companies as to their desirability. In this connection metal to metal brakes are being seriously considered by some operators.

The all-steel body still persists although the hardwood, soft-aluminum combination is still in the lead in larger vehicles. A single decker with a fabric covering was shown at Atlantic City, but this type of bus has not been put into service to any extent. Consideration is being given to the outside finish of the bus, but no definite tendency has manifested itself so far.—*Bus Transportation*, February, p. 55.

Capital Turnover and Profits

C. A. Musselman discusses the growing attention that is being paid to the bearing that capital turnover has on productive profits. The large maker who controls directly his supplies, parts and—even in some cases—his materials, can make a substantial portion of his profits from the economies effected by such control even with a limited turnover of inventory.

An example is given of one of the largest makers of six-cylinder cars in 1923 who showed a profit equal to 12 per cent of gross sales and turned over his working capital four times during the year. Another maker, who produced only about one-twelfth as many cars, obtained a net profit of 9 per cent and turned his working capital over six and a half times.

It is this ability to turn over capital more often that enables the small manufacturer to compete with more important manufacturers.

The smaller manufacturer who does not need to contend with the purchase of raw material and the tooling up for mass production can control his purchases approximately every sixty days and Mr. Musselman states that success in the future will be largely determined by the ability of the manufacturer to expand or contract his production without tying up the maximum capital for a long period.—*Automotive Industries*, March 19, p. 527.

New Engine Indicator

The Dobbie-McInnes Co. has been making indicators for various engines for years and has now developed this electro-pneumatic apparatus for high speed engines in which the inertia effects are overcome. It has been used successfully for indicating aircraft engines at all speeds up to 2,500 r.p.m. and diagrams have been obtained from engines in airplanes flying at altitudes up to 21,000 ft.

One interesting thing about this indicator device is that it can be quite remote from the engine under test. This fact is advantageous from the view point of convenience and absence of vibration.

The principle of the indicator is described in the article and there are illustrations given together with typical diagrams.—*The Automobile Engineer* (Eng.), January, p. 9.

Book Reviews

Practical Foremanship. By Glenn Lion Gardiner, M.A. 191 pages 5x7½ in. Published by the McGraw-Hill Book Co., 370 Seventh Avenue, New York. Price $1.75.

It would be difficult to tell how good or how practical this book is without making dozens of extracts from the various chapters. The author is (or was) employment manager of a large automobile plant and he has written the best outline of a foreman's duties and problems that we have seen.

There are ten chapters, specifically listed as covering: Handling Men; Industrial Goodwill; Employment Management; Selecting Men for Jobs; Planning Industrial Activities; Keeping the Quality High; Breaking in the New Man; A Safe Place to Work; Wage Problems and Advantages of Increased Productivity. Any foreman or worker who has ambitions in that direction, who will not get many times the price of the book out of any one chapter, is either far above the average or so far below the desired quality as to be hopeless.

There are no formulas for foremanship and no preaching such as is too often found in books of this kind. It is a straightforward attempt to show that the human element is, after all, the most important, and it gives many interesting examples and cases of the ways in which it affects production and dependability.

The author's key to handling men, "Treat the other fellow as you would like to be treated," gives an idea of the humanness and good sense that pervade the whole book. It is to be heartily commended. Even successful foremen can find suggestions that will prove of value, and the newcomer in the shop executive field will find it invaluable.

Economics of Business Cycles. By A. B. Adams, dean of the School of Business, University of Oklahoma. Two hundred sixty-two pages, 5½x8 in., cloth covers. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.50.

Mr. Adams' book is an analytical treatise of the phenomenon of business cycles that is logical and thorough. It is admirably suited as a text for college courses in business cycles, for which purpose especially it was written. Yet it is suited to the needs of business and financial men and students of business.

The author makes use of empiric knowledge available from many sources as a basis for his analysis of the causes and effects of cycle forces and advice as to how these forces can be controlled to lessen the violence of the changes.

The plan of the book embodies the presentation of an analysis of the nature and characteristics of the modern business system; an analysis of an economic equilibrium; a discussion of cycles and current theories of cycles; and finally the author's conception of the possibilities of the control of business cycles.

This quotation from the author's preface furnishes an understanding of the theoretical position taken by him:

"According to the opinion of the author, business cycles are not inevitable manifestations of our present business system. He opposes the theory that each business cycle is generated by a previous one and itself generates a succeeding one; he does not believe that any business cycle is generated by conditions brought about as a result of a previous cycle. One of the chief objects of writing the book was to show that cyclical fluctuations are not initiated by cumulative forces which move within a charmed circle.

"He endeavors not only to demonstrate the fallacy of that theory, but to point out the specific forces which, when superimposed upon the business world from the outside, generate fluctuations. He has gone further and suggested methods by which organized society may control these generating forces so as to eliminate injurious business fluctuations."

Giant Power—Large Scale Electrical Development as a Social Factor.—Edited by Morris Llewelyn Cooke. Published in March, 1925, issue of The Annals of the American Academy of Political and Social Science.

This volume of 190 pages shows the effect of the wide-spread use of electric power in the home and on the farm, as well as in the factory. The ever-increasing use of electricity and the generating of current in large units, with the distribution correlated by the "giant power" or super power plan, opens new avenues for improved methods and machinery and relieves much of the drudgery and loneliness of isolated localities. An example of this is shown in the section by Martha Bruere, regarding the effect of hydro-electric current in Ontario, Canada.

The volume is divided into six general sections: National Power Programs, Rural Electrification, Labor and Industry, Miscellaneous, Technical, and Legal. In each section are short articles or statements by leading men and women of the various groups. The first section deals with power development in Great Britain, France, Germany and Canada. The farm uses of electricity are given next, and under the third section are the views of McAllister Coleman, the late Samuel Gompers (his last article), Herbert Quick, Irving Fisher and others.

The effect of giant power on national defense is outlined by General Crozier, while the questions of finance, of fuel, of consolidations and of regulation, are each ably handled. All who wish to keep abreast of the development of giant power, should become familiar with this volume.

The Slide Rule. By H. T. Erickson, Boys' Technical High School, Milwaukee, Wis. Thirty-two pages, 6x9 in., paper covers. Published by the Bruce Publishing Co., Milwaukee, Wis. Price 32c.

The slide rule is complicated or not, depending upon how thoroughly the user's understanding of it when he learns to use it. A good slide rule manual is a necessity and this book by Mr. Erickson answers that requirement. It was written especially for the use of students who have nothing more than a common school education.

The usual complement of problems solvable on the slide rule is explained, but especial emphasis has been placed on the processes of multiplication and division and the method of locating the decimal point. An explanation of the fundamental principles and uses of logarithms is a valuable part of the book.

The Principles of Die-Casting

By H. C. Skinner
General Manager, Franklin Die-Casting Corporation

The use of inserts in die-casting — Wide range of uses—Methods of constructing—Examples of castings made with inserts successfully employed

NO FACTOR in the production of die-castings has added more to the scope of the process and at the same time been less discussed than the use of inserts to give added strength or wearing qualities where needed. The low fusing nature of the alloys used in the process, the highest being aluminum, which fuses at about 1,100 deg. F., makes it possible to incorporate in the castings brass or steel inserts, in the form of tubing, stampings or screw-machine parts, to give added strength at some particular point, or to accomplish some special purpose that could not be secured by the usual methods.

To illustrate the wide range of uses and the best methods of constructing the inserts the accompanying illustrations show the successful application of the use of inserts to die-castings as it has been worked out in the Franklin factory during the past thirty years.

In Fig. 24 is shown brass tubing around which has been cast the cover of a wind-shield cleaner. This tube acts as a bearing for the main shaft and takes considerable strain in connection with holding the device in place, a strain to which no die-casting alloy could be subjected safely. By casting with the tubing in place the desired results are secured at little added cost. The method of holding the stem in place, by carrying the thread only a part of the way into the casting, anchors it securely. The portion of thread entering the casting prevents the stem from pulling out while the combination of thread and plain surface prevents unscrewing.

The use of a bushing as an insert is shown in Fig. 25. It is used to give special bearing qualities where they are required at only one point, making it unnecessary to produce the entire casting from a bearing metal. In this case the bushing was made by the Cleveland Graphite Bronze Co., which furnishes a type of bearing having small indentations in the outside. These indentations form a particularly good method of anchorage, as the metal flows into them and shrinks on to the bearing, holding it securely.

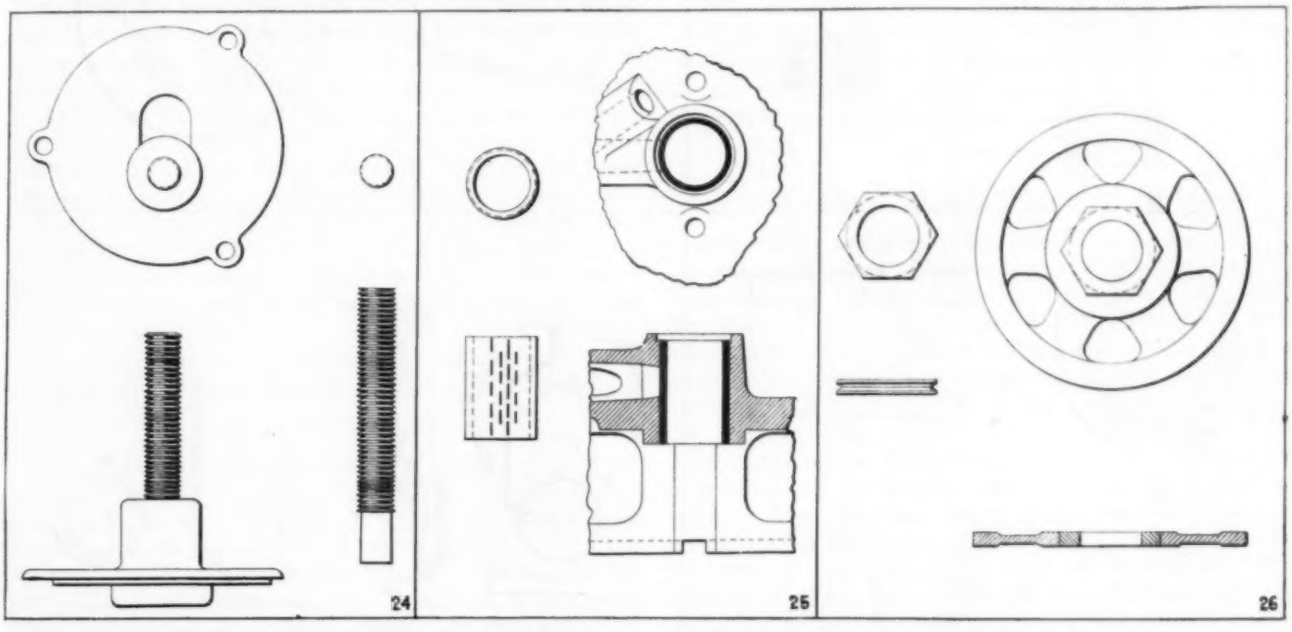


Fig. 24—Insert of brass tubing in windshield cleaner. Fig. 25—Bearing provided by bushing insert Fig. 26—Type wheel die-cast with brass bushing in place

In Fig. 26 is shown a type wheel die-cast with a brass bushing in place. The bushing was provided to take shock and to act as a bearing. This insert is made from hexagonal stock with the outside grooved as shown. The hexagonal shape prevents the insert from turning while the groove insures its not pulling out.

A humidifier nozzle is illustrated in Fig. 27. The action of water on a zinc alloy is, under certain conditions, somewhat detrimental and to insure the proper

The fifth and concluding article. The fourth appeared on page 527.

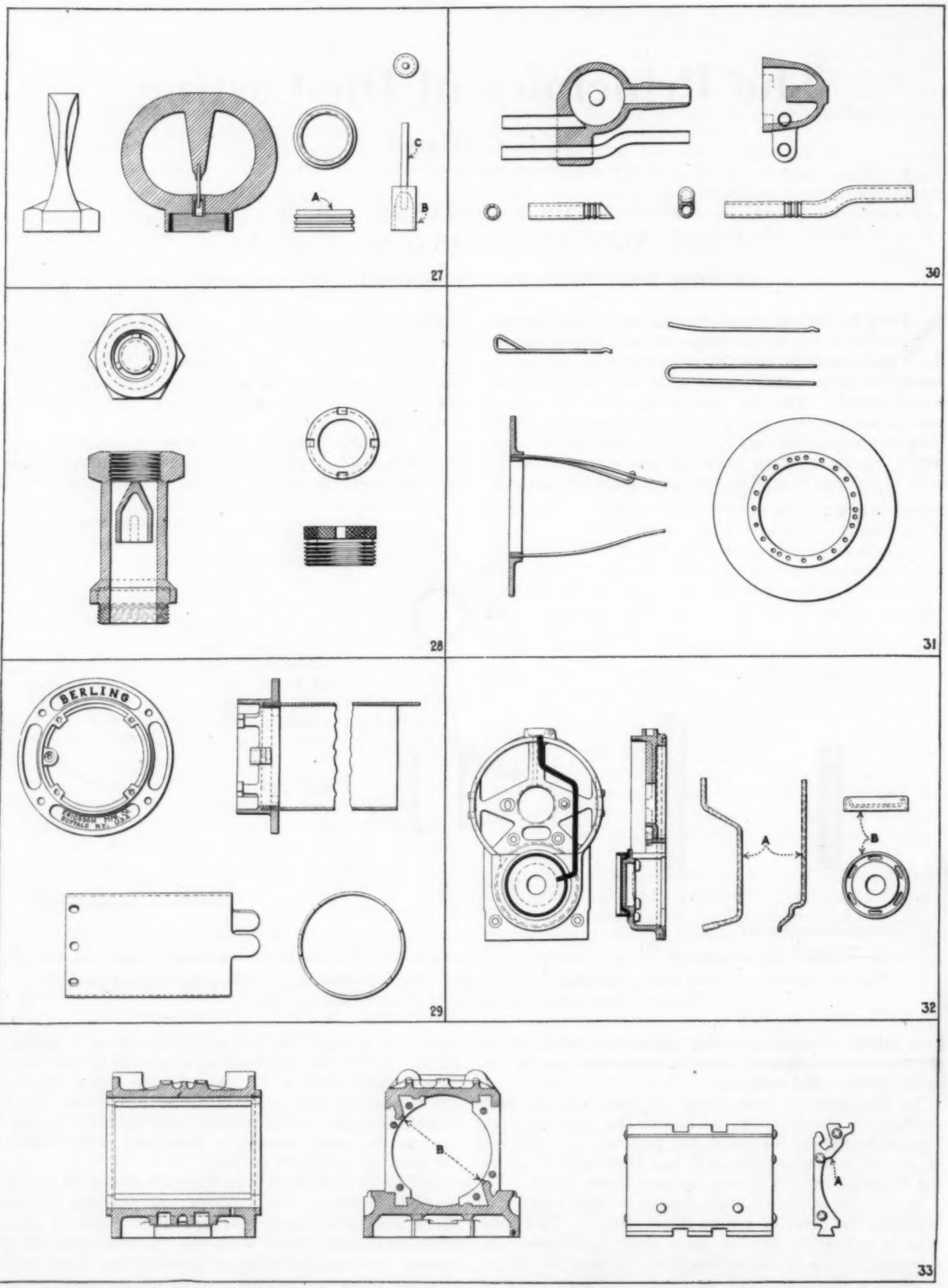


Fig. 27—Humidifier nozzle with three inserts. Fig. 28—Coupling, with insert, used with the nozzle shown in Fig. 27. Fig. 29—Dial, die-cast with large brass tube in place. Fig. 30—Valve body of cow-milker, cast with two brass tubes in place. Fig. 31—Ring, cast around a series of wires. Fig. 32—Oil passage provided by tube insert. Fig. 33—Magneto housing cast with laminated pole pieces in position

working of the part three inserts are used. Insert *A*, which is made of a brass ring, insures threads that are noncorrosive and that will take the necessary strain. Insert *B* insures a noncorrosive channel for the water, while insert *C*, made of German silver, gives, when cut to proper length, a suitable surface against which the water deflects. After the nozzle is cast the pin is cut off a short distance from the bushing and the section that is embedded in the bushing is pulled out. This allows water to pass through the small hole in the bushing and strike the end of the pin. These three inserts have made a successful product out of what would otherwise have been a failure.

Anchorage by Cross Knurling

The coupling illustrated in Fig. 28 is used with the nozzle just described. It carries a brass bushing fitting the threaded insert of the nozzle, thus giving two brass threads at the point of strain and possible corrosion. This bushing is held in place by cross knurling, one of the most common methods of anchorage.

The dial, Fig. 29, has a large brass tube cast in place. It would have been practically impossible to cast the tube of the same metal as the dial on account of its very thin wall, while if the tube had been thickened the weight would have been prohibitive. By using the tubing the weight was kept down while the desired results were secured. The tubing is held in place by the metal that enters holes punched in that part of the tube surrounded by the casting. The anchorage is secure.

In Fig. 30 is shown the valve body for a cow-milker in which two brass tubes are cast. One of the tubes is bent in such a manner that coring would be impossible if that part were to be die-cast as an integral part of the valve. In addition to making proper coring possible the inserts supply strength in a section that would otherwise have been weak and where breakage would have been most likely.

A rather unusual use for inserts is shown in Fig. 31. A main ring is cast, with a series of wires inserted.

Inserted Oil Tube

A part in which the use of inserts has proved particularly effective is illustrated in Fig. 32. On account of the many curves in the tube it would have been impossible to core the passage from the oil well to the bearing cavity, but by using the tube form as shown at *A* the oil passage was made possible. Insert *B*, a stamping, gives secure anchorage for a ball bearing that is pressed into place. The insert is held securely by the metal that enters a series of elliptical holes punched when the piece is blanked.

A magneto housing cast with pole pieces in position is shown in Fig. 33. The pole pieces are for the adjustable spark type and are made as shown at *A*. After the casting operation the pole pieces are bored, leaving the required gap as shown at *B*. The pole pieces are made of laminations riveted together. This type of pole piece is said to give results that are particularly good.

The illustrations given show a few of the cases in which inserts have been adopted with good results and it is hoped that they may prove of assistance to those considering the use of die castings, but who have been held back by the knowledge that some particular section of the part to be produced would not be strong enough if die-cast from any of the usual alloys. The use of inserts has greatly increased the possibilities of die-casting.

Hookworm Draftsmen

By John F. Hardecker

"Jack," said Bill, to the chief draftsman of a large manufacturing concern, "does your organization ever develop draftsmen who are always waiting for some one to give them a decision so they can go ahead, and do they spend a good part of their day doing just that? Hookworm draftsmen, one of my squad bosses calls them."

"Sure," said Jack, "every organization has them in embyro. The trick is not to let them develop.

"The fault lies with their mental habits, they never think ahead. Just so long as they have lines to add, lines they are sure of and which add measurably to the amount of drafting apparent on their drawings, their minds are contented and at rest. And only when they run out of lines, do they come face to face with that major design point which holds them up for decision, the point a good man would have raised days ago.

"Then they begin to wait for an opportunity to raise the question. If you're patient, you can cure some of them by pointing out their fault, but with others its chronic, much too deeply ingrained in the past for you to spend time trying to correct it.

"For them, the remedy is simple. Never leave them with less than three or four jobs ahead, then if they get stuck, as they call it, there's the next job to tackle. If you catch them waiting under these circumstances, it's obviously only an alibi for loafing."

The College Man's Place in Industry

Interesting and pertinent conclusions relating to the question, "What is college training worth to the young man entering industrial life?" may be drawn from the results of a series of studies of the relation of college education to the industries being made by the research staff of the National Industrial Conference Board.

Opinion of executives as to the value of college men in business varies widely. Just how the college trained man fares in the industries, what are his advantages and what his drawbacks, and what is being done to bring college training closer to the practical requirements of the industries is interestingly revealed in the surveys of four industries thus far completed. The results of these four inquiries also disclose that the value of college education, as now conducted, varies somewhat in the different industries.

While "there is always room at the top," a survey of the metal trades industry, for instance, indicates that almost half the positions "at the top" are held by college graduates. This survey covered 318 plants, employing a total of 106,500 persons. Men holding supervisory or technical portions in these plants number 16,002, including 2,742 college trained men. And about one-fifth of these hold 555, or 45.7 per cent of the 1,213 higher executive positions in the general offices of the 236 companies owning the 318 plants.

Major technical positions are held by nearly one-third of the college men, while the sales and distribution departments, which in this industry often require considerable technical knowledge, draw the next highest number, 26.4 per cent, of the college trained men in the industry. The remaining 21.7 per cent of college graduates are found in supervisory and technical positions in the production and commercial departments.

Depreciation Exemption Is Not Always Approved by Tax Commission

A RECENT decision of the United States Board of Tax Appeals of more than passing interest to the machine tool industry was made in the action brought against the Gulf Coast Machine & Supply Co., Beaumont, Texas. The Gulf Coast company claimed an exemption of $2,314.18 for depreciation and this was opposed by the Tax Commission. The following statement is from the report rendered:

"This appeal is from a proposed additional assessment of income and profits taxes for the year 1920 in the amount of $2,314.18, as set forth in the Commissioner's deficiency letter of Nov. 4, 1924. At the hearing, the Commissioner's answer was amended in respect of the amount of depreciation so as to increase the amount of the deficiency asserted in the sixty-day letter. The taxpayer claims a deduction for depreciation, wear and tear, and obsolescence of buildings, machinery and other business assets, which the Commissioner has disallowed as excessive. From the taxpayer's petition, documentary evidence and oral testimony taken at the hearing, the Board makes the following findings of fact:

"The taxpayer is a corporation engaged in the business of manufacturing oil well supplies, drilling equipment, etc., and operating a general machine shop, with its principal office at Beaumont, Texas. It began business in the location occupied in 1920 in the year 1919. The property in question consists of a machine shop and other buildings situated on premises leased from the Santa Fe Railroad Co. under a year-to-year lease containing a clause whereby either party may, on thirty days' notice, terminate the lease. In contemplation of such termination of the lease, the taxpayer in 1922 acquired a tract of land nearby that might be used as a shop site. On this alleged anticipated termination of the lease the taxpayer bases its claim for obsolescence in 1920.

Nearly Exposed to Elements

"The machine shop and blacksmith shop are constructed of steel framing with corrugated iron sides and roofing, as is common in such buildings, the machine shop having a cement floor with a wooden covering. There are other wooden sheds and smaller buildings adjacent. Under the terms of the lease these buildings may be removed by the taxpayer. Because of topographical depression, the premises become flooded during rainy seasons, causing rust and other damage to the machinery and buildings.

"The taxpayer claims a depreciation of 10 per cent on the machinery and equipment, and 20 per cent on the buildings, whereas the Commissioner allowed 5 per cent on the equipment and 10 per cent on the buildings. The present buildings have been occupied for seven years and are still in use. The machinery was acquired from time to time, the more expensive items such as steam hammers, drills and lathes, being bought second-hand.

"In arriving at valuations for depreciation purposes, the taxpayer has used the book value of the property at the close of the year 1920. The Commissioner proposes in his amended answer a computation based on an average of the values of the property at the beginning and at the end of the year, but no evidence was introduced on which to base the proposed computation.

"*Decision.* The determination of the Commissioner of a deficiency in tax for the year 1920, in the amount of $2,314.18, is approved."

What Is a 50-Ton Press?—Discussion

By H. Johnson

Being closely connected with the press manufacturing industry, I will attempt to answer the question in the article by Mr. Kwizzer on page 376, Vol. 62, of the *American Machinist*.

If the capacity of a certain press is given as 50 tons it means that the crankshaft, slide, frame and every other part of the machine are calculated for that pressure with an adequate factor of safety. It is therefore evident that under no condition should this pressure be exceeded.

The next consideration is the relation between capacity and the length of the stroke or to be more accurate the limiting length of the actual working stroke, which is determined by the size of the flywheel used.

It seems to be a general rule among press manufacturers to calculate the flywheel so that it is heavy enough to carry the full capacity of the press through a ¼-in. actual working stroke of the press measured from the lowest position of the ram. In any specific case the salesman will give the figure to the customer. Assuming in this case that a ¼-in. actual working stroke is used as a basis. It is possible to calculate the pressure for any other actual working stroke by the following formula, which for any practical case is correct:

The pressure is inversely proportional to the length of the actual working stroke, or in mathematical terms $\frac{Px}{Pg} = \frac{Lg}{Lx}$, where Px is the desired pressure at any desired length of stroke, Lx the desired length, Pg the rated capacity of the press, in this case 50 tons, and Lg the length of the rated working stroke.

Let it be desired to know the pressure this 50-ton press can safely exert at 1-in. actual working stroke. According to the formula, $\frac{Px}{50} = \frac{0.250}{1}$ or $Px = 12.5$ tons.

As the safe pressure is inversely proportional to the length of the actual working stroke it is evident that this press will evert 25 tons at ½-in. stroke, 50 tons at ¼-in. stroke and 100 tons at ⅛-in. stroke. But, as was stated in the beginning of this article, this 100-ton pressure cannot be allowed because the press is not good for more than 50 tons and this is therefore the determining factor.

If the calculated shearing pressure in this case is 60 tons, a heavier press must be selected, and also if the thickness of stock should require a long working stroke, which, calculated by the formula, gives more than a 50-ton average pressure, a heavier press must be selected.

By making a cutting die with shear a considerable reduction of pressure can be obtained. Also in cutting, for instance steel, the actual working stroke is not equal to the thickness of the material, as shearing takes place when the die or shear is less than two-thirds of the way down in the material.

Railways of Central America and the West Indies

Progress made—Facilities of our country used—Details of present equipment—Tabulation of size, mileage and rolling stock — Examples of shop equipment

THE railroads of Central America and the West Indies have made noticable progress in railroad development in the past ten years, improving transportation facilities, both in the passenger and freight divisions. Many of the roads have doubled their mileage and rolling stock, while others are planning for developments.

The United States Department of Commerce has just issued a report, * presenting detailed information with respect to all the railroads in this territory, covering such phases as the development of the line, the mileage, names of operating officials, method of purchases, finances, number of employees, motive power and rolling stock, repair shops and equipment.

Many of the railroads in these countries depend largely upon the industries of our country for engineering facilities, raw materials, motive power and rolling stock, machine tools and general equipment. The individual lines are not large, yet as a whole they make up a network that covers the territory well, using a large variety of our products. The largest railroads are in Cuba, where twelve principal lines cover the entire island. In other countries, the mileage of the roads is in relation to the area of land they cover.

While the progress made in development has been marked, there is a field for a further increase in operating efficiency and expansion. The rolling stock of the railways is adequate to take care of present passenger and freight business in most sections, yet it is evident that new equipment would be necessary to reduce haulage costs. Some of the locomotives, in present use, date back as far as 1875, and other kinds are second-hand, reconditioned engines purchased from railroads in this country. On some railroads however, there has been advancement, and electricfication of some divisions

*"Railways of Central America and the West Indies," by W. Rodney Long, Transportation Division. In two parts, containing maps and halftones. 376 pp.

Table I—Data on Central American and West Indian Railways

Name of Railroad	Location	Mileage	No. of Locomotives	No. of Cars	Location of Shop	No. of Men	Location of Purchasing Department
International Railways of Central America	Guatemala	654	78	1,575	Panzos & Livingston	...	New York
Ferrocarril Verapaz	Guatemala	28	...	...	Panzos	100	Livingston
Stann Creek Railway	British Honduras	28	4	72	Have none	38	London, Eng.
International Railways of Central America	Salvador	144	12	179	La Union	125	New York
Salvador Railway Co.	Salvador	...	12	160	Sonsonate	150	
San Salvador & Santa Tecla Railway	Salvador	8	3	18	Cutuco & San Salvador	...	San Salvador
Honduras Railway	Honduras	66	28	151	Laguna	100	New Orleans
Cuyamel Fruit Co. Railway	Honduras	47	9	342	Cuyamel	50	New Orleans
Ramal Del Ulna	Honduras	100	14	376	Puerto Cortes	150	New Orleans
Standard Fruit & Steamship Co. Railway	Honduras	196	30	642	La Ceiba	147	New Orleans
Tela Railroad	Honduras	175	18	457	Tela	123	New York
Trujillo Railway Co.	Honduras	186	22	160	Puerto Castilla	300	New York
Pacific Railway of Nicaragua	Nicaragua	156	17	176	Managua	150	New York
Northern Railroad Co.	Costa Rica	331	23	1,164	San Jose & Port Limon	429	New York
Pacific Railway	Costa Rica	86	15	157	San Jose	90	San Jose
Panama Railroad	Panama	161	24	1,014	Balboa	...	New York
Chiriqui Railway	Panama	57	3	25	David City	...	Chiriqui
United Fruit Co.'s Railways	Panama	256	36	547	Almirante	225	New York
United Railways of Habana	Cuba	1,941	381	11,988	Cienaga & Luyano	1,100	New York
Mariano & Habana Railroad Co.	Cuba	21	...	...	Cienaga & Luyano	...	Habana
Habana Central Railroad Co.	Cuba	67	13	307	Cienaga & Luyano	600	Habana
Habana Terminal Railroad Co.	Cuba	2¼	...			...	Habana
Western Railways of Habana	Cuba	16	30	747	Cienaga & Luyano	...	Habana
Cuban Central Railway Co.	Cuba	363	83	2,707	Cienage & Sagua	...	...
Cuba Railroad Co.	Cuba	891	165	6,155	Camaguey	...	New York
Cuba Northern Railroad	Cuba	202	43	1,564	Maron, Camaguey	420	Maron
Hershey Cuban Railway	Cuba	76	13	282	Hershey, Cuba	43	Hershey,Cuba
Guantanamo & Western Railroad Co.	Cuba	91	17	586	San Justo	250	Guantanamo
Guantanamo Railroad Co.	Cuba	58	9	299	Guantanamo	...	Guantanamo
Habana Electric Ry., Light & Power Co.	Cuba	186	12	594	Vedado	20	Habana
National Railway Co. of Haiti	Haiti	109	7	76	Supplice	...	New York
Terrocarril Central Dominicano	Haiti	62	12	144	Puerto Plata	75	New York
Samana-Santiago Railroad	Haiti	97	11	162	Sanchez	...	New York
Jamaica Railway	Jamaica	200	28	465	Kingston	...	Kingston
American Railroad Co. of Porto Rico	Porto Rico	125	52	1,392	San Juan & Ponce	455	New York
Ponce & Guayama Railroad Co	Porto Rico	48	7	521	...	...	San Juan
Porto Rico Railroad Co	Porto Rico	...	6	199	Rio Piedras	...	San Juan
Trinidad Government Railway	Trinidad	115	37	843	Port of Spain	...	Port of Spain
Barbados Railroad	Barbados	24	5	17	Bridgetown	10	Bridgetown

has been accomplished, while other roads are planning for electrically operated lines in the near future. It is surprising to note that a few roads burn wood, obtained locally, for light service and switching purposes. For ordinary service coal is used.

There seems to be a lack of efficient signal operation, many of the roads having hand-operated signals or dispatching by telephonic communication. Owing to the irregular surface of the land, necessitating many curves, bridges and tunnels, this method of signaling has a tendency to hinder efficient transportation.

Table II—Equipment of the Camaquey Shop of the Cuba Railroad Co.

Description	Belt or Motor Driven	Condition	Age (Year of Purchase)
50-ton bushing press, Niles	Motor	O. K.	1922
35-ton bushing press, Watson Stillman	Belt	O. K.	1916
Grinding machine, Yankee drill grinder	Belt	Bad	1905
Grinding machine, Cincinnati Milling Machine Co. (tool room)	Belt	O. K.	1905
No. 2 milling machine, Kearney & Trecker	Belt	O. K.	1905
16-in.x6-ft. Le Blond engine lathe (tool room)	Belt	O. K.	1918
16-in. back-geared crank shaper, Gould & Eberhardt (tool room)	Belt	Bad	1905
Wm. Sellers No. 2 tool grinder (tool room)	Belt	O. K.	1918
Westinghouse improved test rack (air-brake room)	.....	O. K.	1920
Semi-automatic valve-finishing machine (air-brake room)	Motor	O. K.	1922
16-in.x6-ft. Le Blond engine lathe (air-brake room)	Motor	O. K.	1918
42-in. double-carriage lathe, Niles-Bement-Pond Co.	Belt	O. K.	1916
24-in. swing turret lathe	Motor	O. K.	New
18-in. No. 3 universal geared turret lathe	Belt	O. K.	New
No. 2 Landis universal grinder	Belt	O. K.	New
No. 2 Sellers drill-grinding machine	Belt	O. K.	New
No. 85 wet tool grinder, Safety Emery Wheel Co.	Motor	O. K.	New
32-in. back geared, Cincinnati shaper	Motor	O. K.	New
80-in. driving-wheel lathe, Manning, Maxwell & Moore	Motor	O. K.	New
96-in. 600-ton driving-wheel press	Motor	O. K.	New
5-ft. radial drilling machine, Niles-Bement-Pond Co.	Motor	O. K.	New
Four 19-in. quick-change, heavy-duty Le Blond lathes	Belt	O. K.	New

Note—All other equipment is in such condition and of such character that it is not worthy of consideration. Floor area, 32,480 square feet.

The railroads receive the majority of their revenue from freight haulage, which on some roads is more than three to one in ratio when compared to passenger traffic. On some roads no passenger service is given, while on others there are only a few passenger trains daily. The freight consists largely of agricultural products, raised locally, such as sugar, coffee, cocoa, tobacco, bananas and other tropical fruits.

Tabulation of Railroads

To give a more thorough knowledge of the size, mileage and rolling stock of the Central American and West Indian railroads, Table I has been compiled. It contains statistics taken from the monograph previously referred to. There are a large number of privately owned railways, scattered around these countries, which are not listed, because their mileage is not more than 10 per cent of the total railroad mileage in these countries.

The larger railroads maintain their own repair shops, while the smaller roads attempt only running repairs and depend upon outside sources for heavy repairs. In most of the shops, foundry equipment is available, handling work up to several thousand pounds in weight. One of the largest foundries has a capacity per month of 10 tons of brass and 20 tons of iron. The railroads that do not have shops or foundries suitable to take care of general repairs find it necessary, when in need of a part for a locomotive or coach, to import one, delaying work considerably.

Since 1919, one of the roads, operating over 100 miles of track, has purchased 14 locomotives, and the work shops are now inadequate to maintain all engines in a satisfactory state of repair. Most of the existing machine tools in these shops are at least 15 years old.

As an example of equipment used, that found in the shops of the United Fruit Co.'s Railway in Panama follows:

Cleveland punch and shear, motor driven.
Niles-Bement-Pond steel planer, 36 in. x 10 ft., motor driven.
Niles-Bement-Pond wheel press, 250 tons, motor driven.
Niles-Bement-Pond wheel lathe, 50-in.
Bullard boring mill, 52-in.
Cincinnati milling machine No. 3.
Ingersoll-Rand compressor, single stage, 10x10-in.
Reed lathe, 20 in. x 12 ft.
Reed lathe, 20 in. x 8 ft.
Reed lathe, 20 in. x 6 ft.
Lodge & Shipley lathe, 14 in. x 6 ft.
Cincinnati gap lathe, 14 in. x 6 ft.
South Bend lathe, 18 in. x 8 ft., motor driven.
American tool-room lathe, 16 in. x 8 ft., motor driven.
American heavy-duty lathe, 18 in. x 10 ft., motor driven.
Bradley electric strap hammer, 250-lb.
American radial drill, 4-ft., motor driven.
Cincinnati shaper, 24-in.
Cincinnati shaper, 18-in.
Four drill presses, 16-in.
Landis bolt cutter.
Oxweld portable cutter and welder.
Wilson portable electric welder.
Railway cut-off saw, 24-in., motor driven.
Two ripsaws, 18-in., motor driven.
Surfacer or buzz planer, 24-in., motor driven.
Wood planer (light), 18-in., motor driven.
Four blacksmith forges, with fan.

The general machine shops are located at Almirante, while a small repair shed is situated at Guabito. The machine shop has a capacity for repairing 8 locomotives, 16 cars, and 2 or 3 coaches and cabooses at one time. The number of employees at capacity is about 225. The boring mill and planer will take care of a 3-ton casting.

A Cuban Railway's Equipment

The Cuba Railroad Co., which has the second largest mileage of any individual road, maintains a number of shops, the principal one at Camaquey, an auxiliary shop at Santiago and chief interchange and repair points at Santa Clara, Cumbre, Ciego, Florida, Miramar and San Luis. Materials for shop maintenance and repairs are purchased through the New York office. The equipment of the Camaquey machine shop is listed in Table II, which gives the ages of the machine tools, also the kind of drive and the condition.

Other shops at Camaquey are a roundhouse, a boiler-washing plant, a foundry, a freight car shop with a capacity of 52 cars, a coach repair shop with a capacity of 12 cars, a painting and varnishing shop, a freight car machine shop and a blacksmith shop. An 800-hp. power plant is maintained, including air compressors, water heaters and various pumps.

The Handling of Obsolescence by Manufacturers

THE following suggestions relative to the handling of obsolescence are taken from the experience of a considerable number of representative manufacturing companies:

1. Assemble all obsolete parts at inventory time and decide whether they are to be scrapped or used in some other way.

2. Where items have been deemed obsolete, a limited number of pieces should be reserved to take care of repair and replacement parts.

3. Obsolete parts carried in reserve should be shown at nominal or salvage value.

4. Where parts become obsolete because of change in design, the stores department should be notified and the parts changed, either scrapped or, if there is any chance of their future use, priced at a nominal figure.

5. To provide for the best utilization of changed parts, a list of them should be supplied to the engineering department or to the designing department so that it may be in a position to develop other uses for such items.

6. The head of the stores department should report balance cards, which show no withdrawals, for which items a determination should be made as to whether or not they are to be considered obsolete.

(*a*) Once a year, at least, a review should be made of stores for which permanent inventory records are maintained, and any materials, finished parts, or completed apparatus having had no activity, or very slight activity, during the past year should be listed, and the engineering and sales department thereupon consulted to determine whether the items should be depreciated and held, changed to render them usable, or scrapped. A similar procedure should be used for reporting inactive stocks in warehouses.

Salvage Departments

7. Where obsolete stocks cannot be immediately used, the advisability of placing them in suspense stock should be considered. Large companies maintain a salvage or obsolete materials department to which excessive stocks are transferred and card records maintained thereof by quantities and description.

8. Before a change of existing design in a standard line is authorized, a request should be sent to all points at which may be kept stocks of raw materials, finished parts or completed apparatus belonging to the line under consideration, to ascertain the quantities and values of such stock. Such reports should then be summarized and the approximate cost of the change in design under consideration be determined before final action is taken.

9. Where stocks of raw material and finished stock are kept on a set maximum and minimum basis and such maximum and minimum are varied in accordance with demand, quantity and parts on hand of lines to be discontinued should usually be low. This is suggested, inasmuch as lines are not discontinued on the spur of the moment, but only on account of dwindling demand.

10. A list of material declared to be obsolete should be furnished to the purchasing agent to enable him to dispose of such material at the best realization price.

Molds, dies and patterns are almost in a class by themselves so far as obsolescence is concerned. It is the practice of a number of companies to keep these on hand almost indefinitely as a matter of service. Irrespective of the cost, the companies retain them to take care of the possibility of a call for them.

"We keep a record of the cost of storing and handling patterns, etc.," writes an official of a company, "but when it comes to discarding these, the company's business policy has more to do with it than the expense of keeping them."

"Whenever our tool and pattern spaces become crowded," writes an official of an electrical manufacturing company, "we review our records with the superintendent of the department, the engineering department and sales department and among them an agreement is reached as to which tools and patterns may be scrapped and as to those which shall be retained."

An Example of Practice

It is extremely important to have a definite policy relative to patterns, molds and dies. The following is the practice of a representative company:

1. All special patterns are scrapped immediately.

2. All patterns for items declared obsolete are scrapped immediately.

3. Patterns which are difficult to make and for which there is a reasonable business chance of repeat orders are kept for a period of five years.

4. Patterns belonging to the regular line are depreciated according to the number of times used.

5. No pattern, even though occasionally used, is carried for more than ten years. Thus, the minimum depreciation rate is 10 per cent.

6. Those patterns which are more frequently used are given increased depreciation rates and such patterns are segregated.

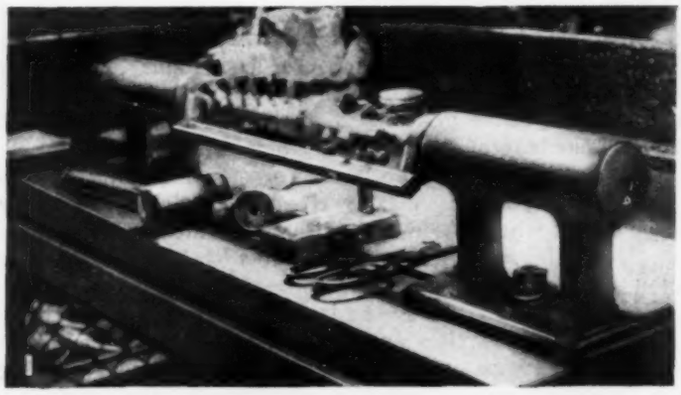
There is coming into general use the practice of carrying molds, dies and patterns at a fixed amount representing a conservative value for the working complement in active service. When additional equipment is required for manufacturing standard lines of product, it is charged into cost as the expenditures are made. Expenditures required to manufacture special orders of apparatus for specific customers are then charged to an inventory account and absorbed in cost as the order is shipped.

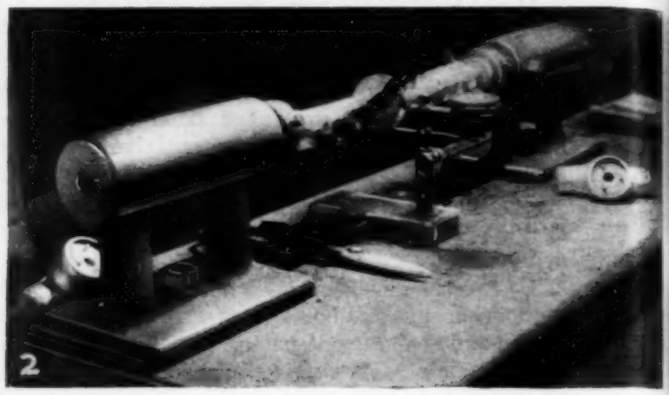
While the cost of storing and administering patterns, molds and dies is not excessive in most companies, it does mount up for larger manufacturing enterprises. One company keeps the cost of storing and administering patterns on a cubic foot basis.

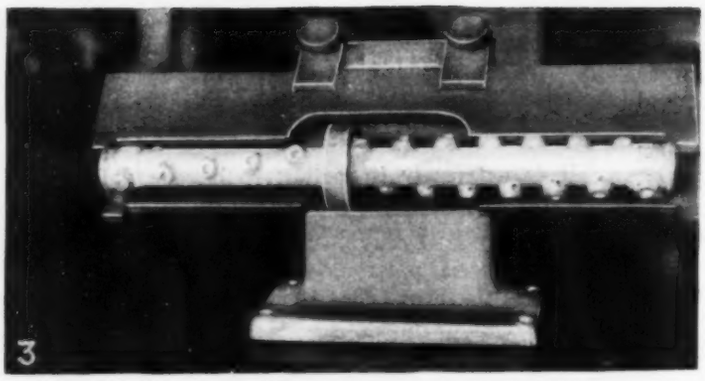
The pattern storage department is, of course, a non-productive department. To such department should be charged all the direct expense necessary in maintaining it and also its pro-rated share of all the indirect burden, such as insurance, taxes, etc. At stated periods the total expense of departments should be pro-rated over all the productive departments and absorbed as general overhead expense by them.

If such accurate account is kept of the costs of storing and administering patterns, molds and dies, it is felt that a more definite policy of scrapping old and discarded patterns could be adopted.

Extract from the pamphlet, "Reducing Losses from Obsolete Material," published by the Metropolitan Life Insurance Co.







Inspection Gages and Methods

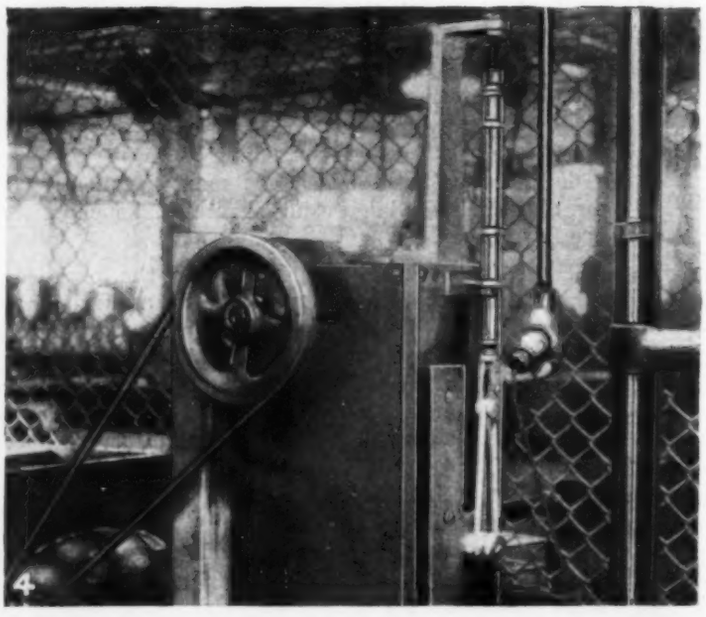
Vacuum Sweepers

THE first three gages are used to inspect the revolving brush of the Hoover sweeper. Fig. 1 shows the test for the length of the bristles, which are held to rather close limits for work of this kind. In Fig. 2 the concentricity of the pulley that drives the brush is inspected by the dial gage, the brush being held at each end in hollow centers or chucks.

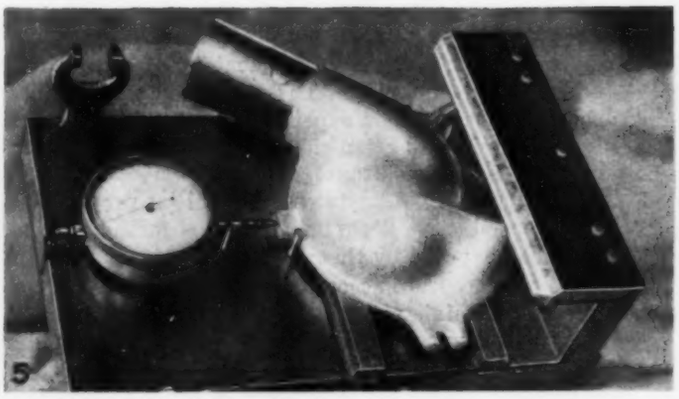
The length of the brush body is tested in the "go and no go" gages in Fig. 3. The gages are both held in one frame at convenient distances apart to save needless motions.

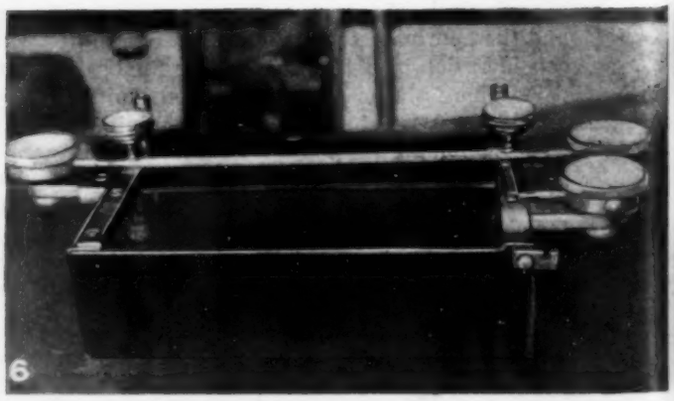
In Fig. 4 is a new machine for testing the rubber bands that drive the brushes, the tension being important to secure best results.

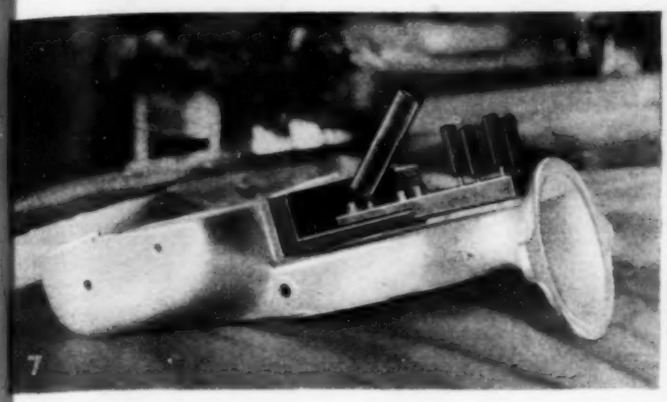
The suction connection in Fig. 5 is gaged carefully at several points. The face rests on two hardened strips and the two wings contact the upper bar, while the dial gage indicates the lug. The width of the lug is measured in the snap gage shown at the corner. The brush shaft is gaged both for diameter and length in the device in Fig. 6. Two dials gage the end diameters and two the length. The distance between shoul-



Photographs by courtesy of the Hoover Company, Inc.



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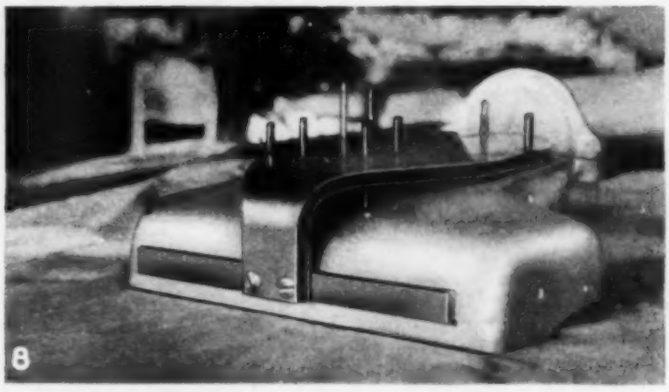
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ders is gaged by the front dial at the right. The shoulders contact the left-hand steel strip and the movable arm at the right.

The body of the sweeper, or drum, is gaged at many points, a few of which are shown in Fig. 7. The surfaces at right angles are gaged as to squareness and also their relation to the holes into which the plugs fit.

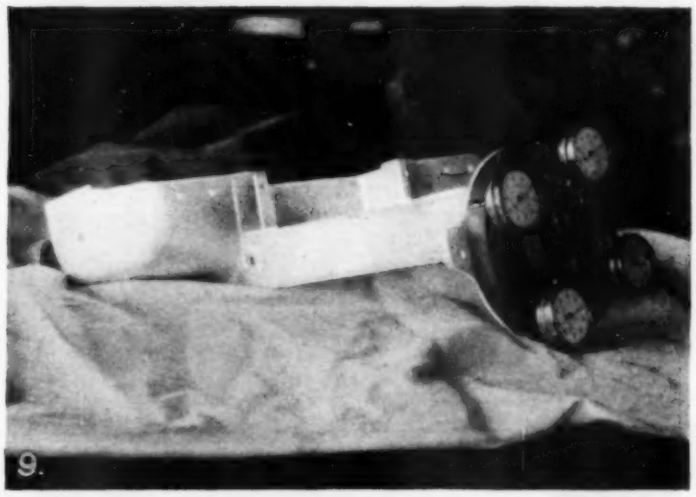
Another gage, for the location of more holes, is seen in Fig. 8. This gage locates from the front surface of the drum casing.

In Fig. 9 is a gage carrying four dial indicators, for testing the squareness of the flange on the end of the body. The flange carries the dust bag and must be flat and airtight. The steel disk fits against the face and the indicators show any variations at the different positions.

An unusual gage for testing the shoulder distance between the hub and the rim of the case is shown in Fig. 10. The edge of the case rests on the four hardened-studs in the base, and the hub fits over the central stud. This stud is connected by lever with the dial indicator and shows whether or not the distance is correct.

Another part that must be airtight, is that shown in Fig. 11. The rectangular joint is at 90 deg. and the gage is a refined angle plate, making inspection easy and rapid.

A second inspection on the same piece is shown in Fig. 12. The flange rests against pins at each end. The dial gages check the distance between the two surfaces.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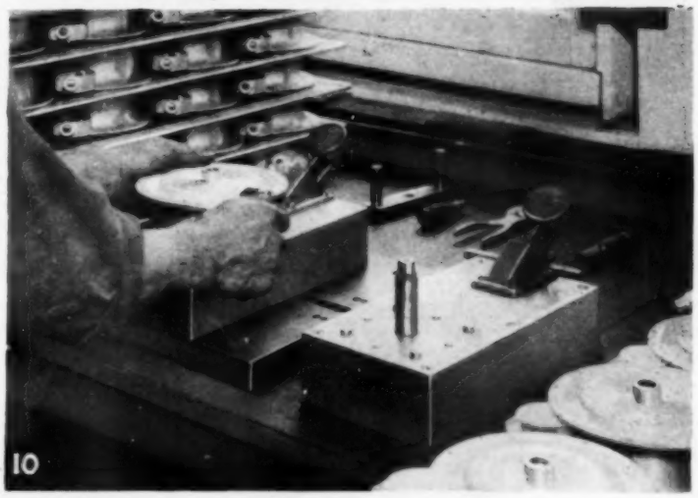
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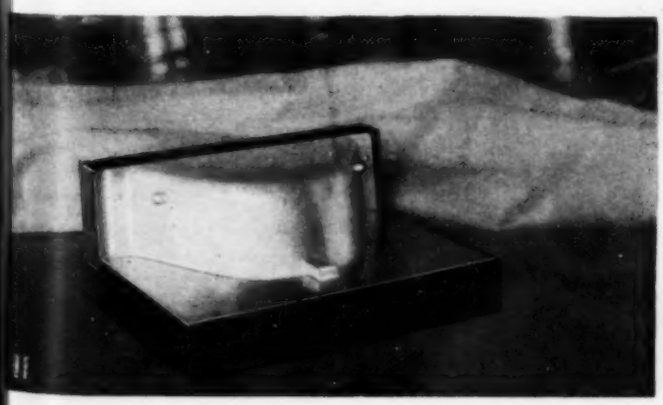
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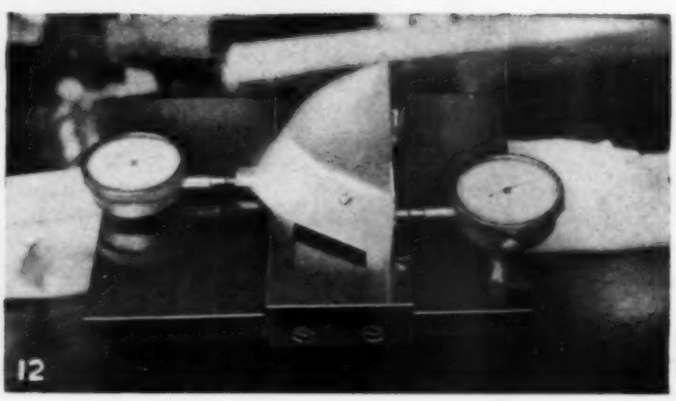
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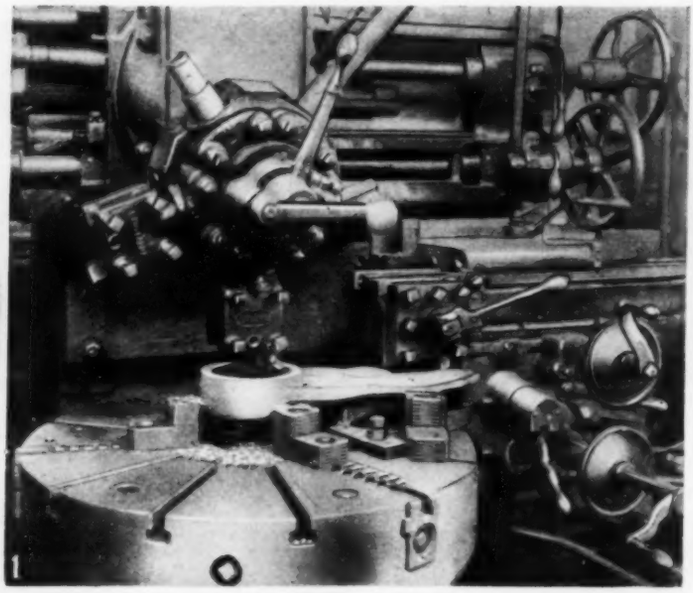
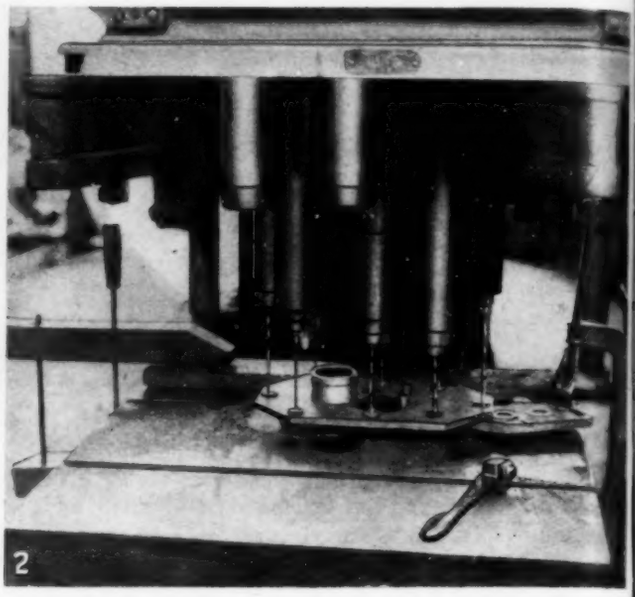
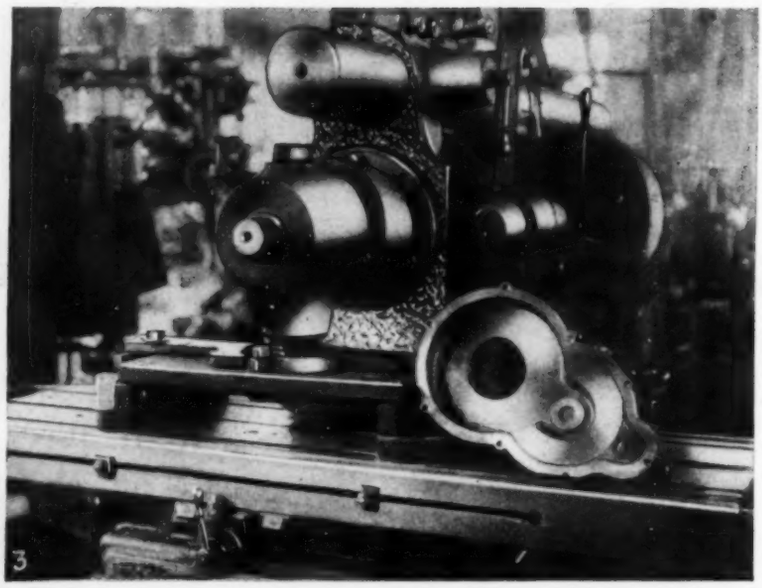






Lawn Mowers in the Making

1—Bore and face side plate on Bullard. Stellite tools—2 cuts, 3 per hour

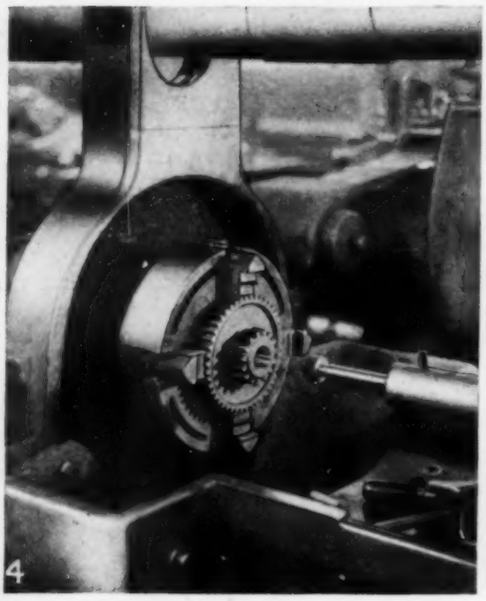
2—Drill 7 holes, 7/32 in. and one hole, 5/16 in. Natco, 25 per hour

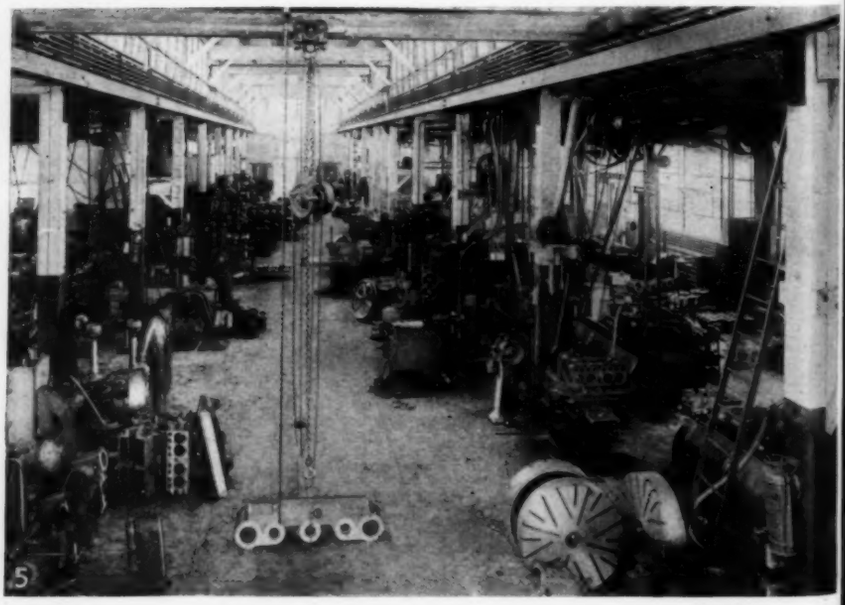
3—Mill face of boss inside, on No. 3 Le Blond. Spiral, high-speed, 2½-in. cutter, 48 r.p.m., 0.080 in. feed per rev. Tolerance 0.008 in. 40 per hour

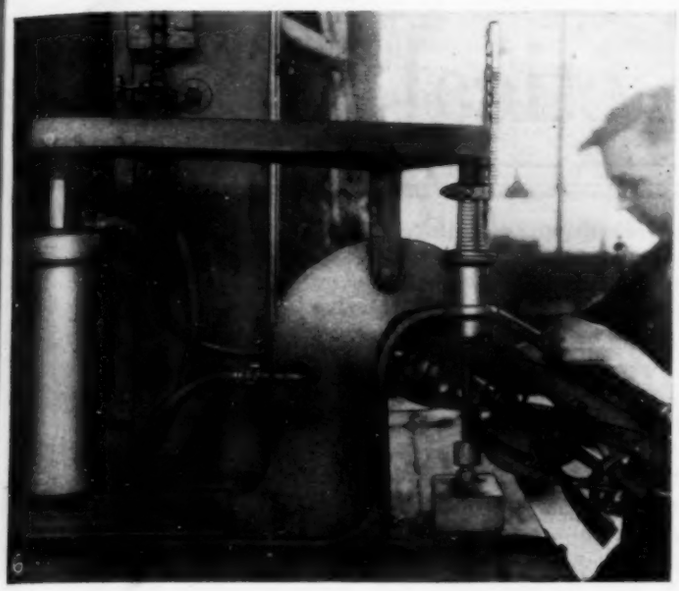
4—Grind hole in gear, on Bryant. Remove 0.006 in. Hole, 1x1⅝ in. Wheel speed, 4,000 r.p.m. Work speed, 248 r.p.m. Tolerance 0.0005 inch

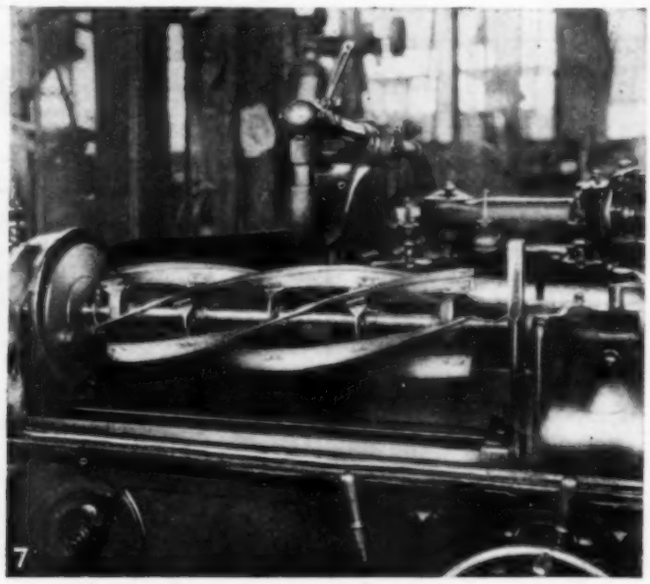
5—Main aisle of shop

Photographs by courtesy of the Toro Manufacturing Co.









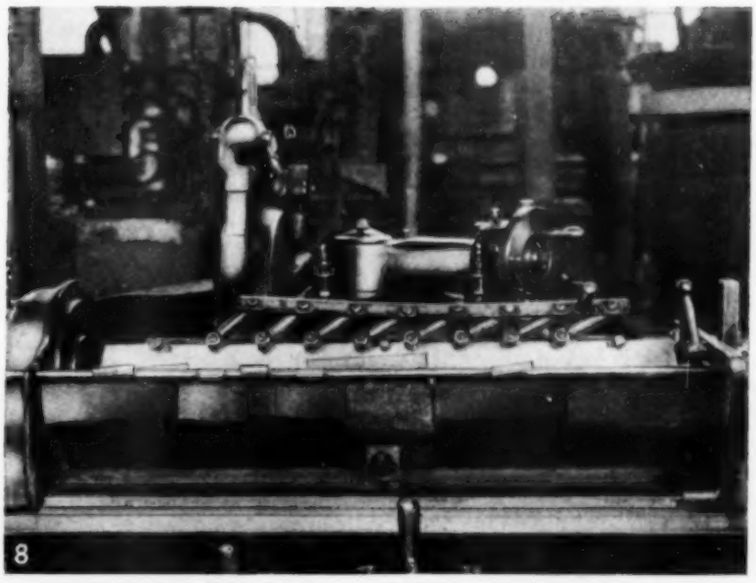
6—Riveting blades to reel frame. Rivets, ¼x¾ in. iron. Home-made arbor press and air cylinder. Note fixture. 3 per hour

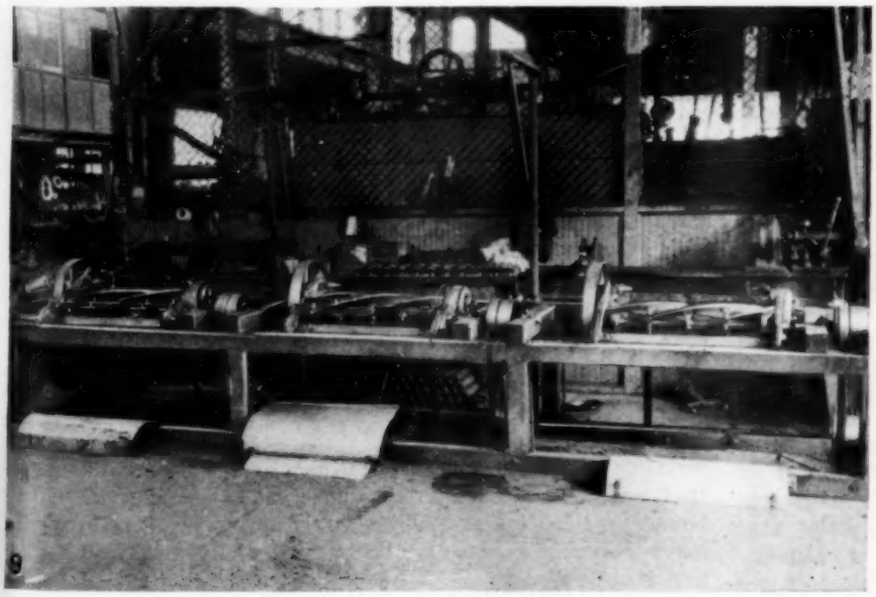
7—Grinding outside of reel, on Landis. Remove 3/32 in. to leave 8¼ in. diameter. Wheel, 18x3 in., 6024M, 1,200 r.p.m. Work 70 r.p.m. 40 per hour.

8—Grinding knife-bar on Landis. Knife clamped by 8 bolts at proper angle. 6 per hour

9—Running in lawn mowers with abrasive and oil. Cutter runs backward. Each blade tested with thin paper. About 2 per hour

10—Assembling lawn mowers. Note revolving fixture of pipe fittings





Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Using Old Castings as Patterns

BY DONALD A. HAMPSON

Many broken castings have to be replaced by new ones, rather than welded, and the cost of making a pattern for each such casting is out of proportion to the apparent worth of the casting itself. It is in such cases that the broken casting may be used advantageously for a pattern.

Where the amount of shrinkage is not a serious item, this practice saves a good deal of time, delay and money. A casting that is not intricate and that is not broken into little pieces can be made into an acceptable pattern. I say *acceptable*, because there is a well founded resistance on the part of molders to using old castings as patterns—based largely on the condition of such castings as are ordinarily sent to them.

A good deal of the molder's work is done in the dark and consequently patterns, to work out efficiently, must be made with this in view. And, since foundry prices are invariably on a per pound basis, anything that slows up the work is looked upon with disfavor by both bosses and men. Wood patterns are made divided, have plenty of draft, are finished with a coating that sheds sand easily, and do not have pockets and catchy spots on their surfaces. The broken casting from which the molder is asked to produce a good one, on the contrary, may be in several pieces but never happens to be broken along the parting line. Its surface may be greasy or smutty, it may have little or no draft, and there may be any number of pockets—small to be sure—and screw holes to tear away the sand as it is drawn.

Grease and oil are the molder's particular enemies. An oily casting that has merely been wiped off, will raise no end of trouble when drawing it out of the sand. The proper thing to do, is to put the casting in a fire or flame and burn off all the oil and grease. A torch passed over the surface will answer very nicely in many cases. The heat leaves a certain amount of residue that can be taken off with a brush, when the casting will be in a condition to shed sand with the least trouble.

The less patching of the mold that has to be done, the nearer will the casting approach the original form. Any pimples or swells on the original, any partings that may not have been well ground off, any holes—must all be attended to in order to avoid tearing the sand. Back draft does the same thing. Holes (defects) in the original casting can be filled acceptably with iron filler, putty, or wax. Drilled and tapped holes may have wooden plugs driven in or be filled by steel plugs or sections of old bolts, but it is as important to see that the plugs do not project as it is to fill the holes with something to keep the sand out.

The matter of holes is not as serious as a sticky outer surface. It doesn't take a molder long to stop holes with core sand—in fact, he can often combine such a filling with a much-to-be-desired draft at a certain point.

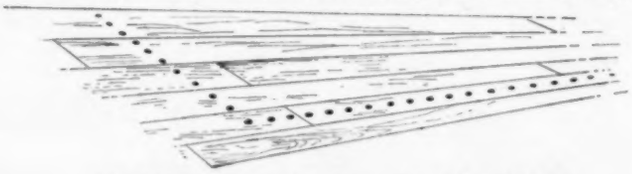
It is more important to provide means to lift the casting than to plug all the small holes. If there are no holes that can be used for pins or rods, at least two should be put in, and, if the molder has none, a pair of lifting rods should be sent along with the pattern to the foundry.

Marking Aisles Permanently

BY HENRY C. FRANCIS

The marking of aisles to serve as a dead-line for the stacking of materials so as to insure a free passage way, has become an almost universal custom in most shops. Just how to mark them has been, and is, something of a problem.

The usual method is to paint a white or light-gray line, perhaps two inches wide, along each side of the aisle to show the boundary line. Paint however, is not permanent and wears off or becomes soiled from truck wheels, shoe soles or dragging boxes and castings over the line. Strips of metal have been nailed down in some shops, but is not usually satisfactory as the strip is sure to be torn loose at some points by sharp ends or edges of material catching in the metal.



Marking aisles with large-headed nails

Having tried various methods the Ingersoll Milling Machine Co., Rockford, Ill., some time ago adopted the plan shown herewith: It was found that nails with flat steel heads about an inch in diameter could be bought in the open market. The nails were purchased and driven along the boundary lines for the aisles, about 4 in. apart, as shown. They mark the aisles very plainly. The heads are kept bright by the shoe soles that pass over them and the question of keeping the boundary lines intact and visible is no longer a problem. The only expense is in buying the nails and driving them in place.

IDEAS FROM PRACTICAL MEN

Handy Tumbling Barrels for Small Work

By William Denton

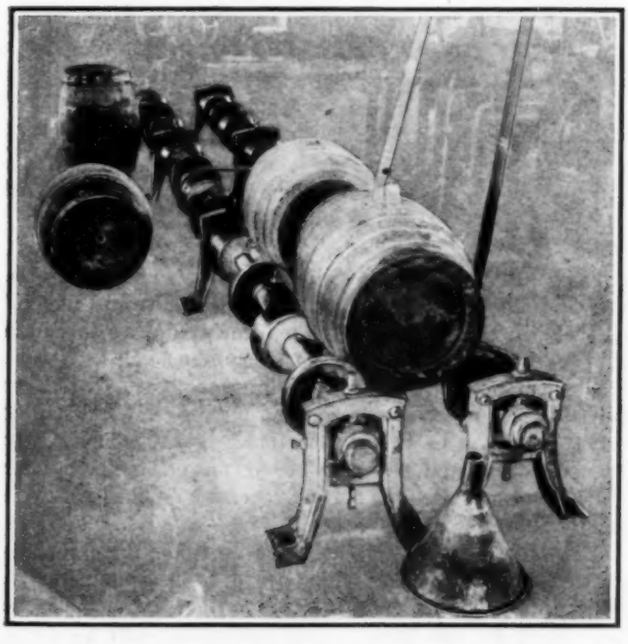
About every shop that manufacturers small parts of any kind has to have one or more tumbling barrels, and there are many such barrels on the market from which to choose, some of them quite elaborate machines with prices to correspond and others that are little more than plain cylindrical or octagonal containers, with a couple of journals and bearings upon which to rotate.

In the good old days when a shop proprietor needed another tumbling barrel, the boss millwright got a cask, screwed a cast-iron flange to each head, stuck a couple of pieces of cold-rolled into the hubs of the flanges and fastened 'em in with setscrews. A pair of shaft hangers, with boxes, turned upside down on the floor completed the outfit and a belt passed around the barrel and over the line shaft furnished the power to drive it.

In the outfit shown in the accompanying illustration a somewhat more elaborate drive is provided, but for the barrels themselves no preparation is needed; just the bare casks as they are delivered from—well! wherever it is you get them from. Since these particular barrels are used to polish bearing balls, the work can be poured into the bung-hole through a funnel. If the pieces were larger maybe the millwright would have to cut a door in the side of the barrel and provide a way to fasten it.

Two shafts, running in ordinary short shaft hangers on the floor, are each provided with beveled disks—two for each barrel—and are driven by belt from whatever shaft may be convenient. Both shafts run in one direction and both should be driven. When a barrel of work is to be changed, two men lift it by the chimes and set it on the floor. When it is reloaded it is put back on the disks in the same manner.

Where there is a row of barrels, as in this case, that are to be attended by one man, it is well to bore a small hole at the center of each head so that it can be lifted with a double hook—something like a pair of ice tongs but wide enough to span the length of the barrel—suspended by a small chain fall from a trolley overhead. With this rig one man can handle the barrels without assistance and without stopping the other barrels.



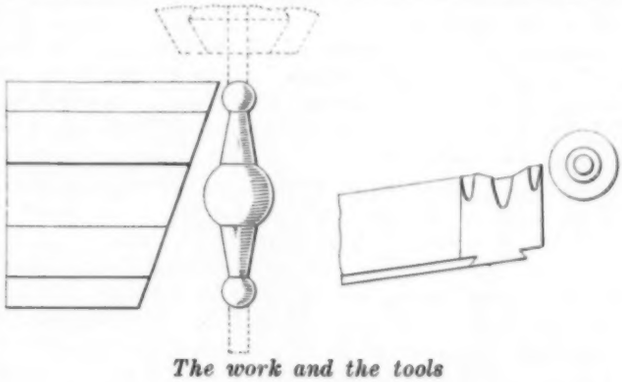
Tumbling barrels for small work

Chasers for Threading Fiber—Discussion

By C. E. Bliven

The article under the title given above, by Charles A. Reimchissel, published on page 1009, Vol. 61, of the *American Machinist*, recalls an experience of mine some twenty-five years ago in connection with an automatic machine used on brass work for plumbing supplies.

The piece to be machined was a small brass casting having three balls connected by two tapered spacers as shown in the illustration. On each end of the piece there was a small cylindrical boss by which it was chucked and held during the forming operation, these bosses being cut off before the piece was finished.



The work and the tools

The job was tooled to use an undercut forming tool on the cross-slide of the machine, and this tool had the usual clearance and rake. In addition it was cut at a rather steep angle across the cutting edge in order that the full width of the cut would not be on the work at any one time. The machine and tools had been tested, presumably, before leaving the factory and had been passed on as being satisfactory.

When I came to set up the job I was unable to get the work finished without chatter marks—sometimes very light and sometimes quite heavy. Chatter marks, however light, meant another operation before the piece could be finished, and added to the labor cost—besides, the machine was sold with the understanding that the job could be finished satisfactorily by forming.

Try as we would, we could not eliminate those chatter marks. Finally one of the "old timers" suggested grinding a negative rake on the forming tool. No one else had any faith in the idea, but we tried it and got good results. Later, the clearance angle was reduced nearly to zero, so that the piece almost burnished itself on the tool.

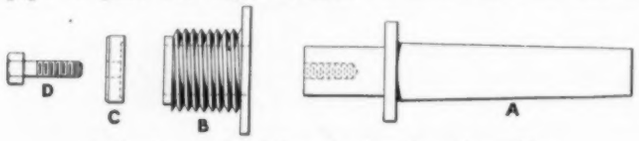
The old-timer's suggestion saved the sale of the machine for us, and the youngster to whom it was given has never forgotten his kindly interest and sympathy for a stranger in trouble.

IDEAS FROM PRACTICAL MEN

A Kink in Threading Large Pipe

By S. B. Richey

For holding standard iron pipe in a lathe for threading, a cone center for the tailstock is better than nothing at all—which is about all that can be said for it. It centers the inside of the pipe approximately, but as the pipe is to be threaded on the outside, it is the outside that should run true. In case the piece of pipe is just the right length, it is difficult to cut a



A device to hold large pipe for threading

thread on both ends without turning it end for end in the lathe, and then the threads will not be true with each other, as would be the case if both threads were cut at one setting.

Having a large amount of 17-in. O.D. pipe to cut and thread in a 30-in. lathe, I made up the parts as shown in the accompanying sketch and proceeded as follows: Part *A* was made with a No. 5 Morse taper to fit into the tailstock. Part *B* was made of bronze, bored to a running fit on part *A* and threaded to fit a 12-in. independent-jaw chuck, and about $\frac{3}{32}$ in. shorter than the shoulder of *A* upon which it runs.

The cap *C* was faced and counterbored as indicated by the dotted lines, and when held in place by the capscrew *D*, with the counterbored face toward part *B*, it clamped the latter so that the chuck could be screwed upon it. The cap *C* was then removed and put on in reverse position, allowing the part *B*, with the chuck upon it, to revolve.

In threading pipe that was short enough to swing between the centers of the lathe, one end was held in a chuck on the live spindle, gripping the pipe from the inside, with about $\frac{3}{4}$ in. between the end and the face of the chuck to allow clearance for the facing and threading tools. The opposite end was gripped by expanding the jaws of the 12-in. chuck inside the pipe, allowing the end to extend over the jaws so that a facing tool could be used without danger of running into the chuck. A wrench for the 12-in. chuck was made from a piece of square stock, bent near one end to a right angle.

The requirements were that flanges that were to be screwed on the pipe, should screw up flush with the pipe ends, since the measurements were taken from face-to-face of the flanges with no allowance for screwing up. By cutting both the threads at one setting, the flange faces were parallel, insuring tight joints. In one case, two or three nipples were to be made at one setting of the pipe by cutting grooves at the proper locations, making the diameter at the bottom of the grooves equal to the diameter at the bottom of the threads at the small end. The nipple ends were then turned to the proper taper, making the diameter at the small end equal to that at the top of thread. The various threads were then cut to gage. Each taper was made in one cut and each thread in eight cuts.

After the threads were all finished, the nipple at the tailstock end was cut off and removed, and the tailstock run up to allow the 12-in. chuck to engage the end of the shortened pipe, which was then faced and the next nipple cut off. The operation was repeated until all the nipples were cut off.

Two gages were made of 2x$\frac{3}{8}$-in. flat, mild steel. The ends were drawn out and the pieces bent into a semicircle with the ends turned inwardly about $\frac{1}{2}$ in. One of these gages was used for the bottom and the other for the top of the threads at the small ends.

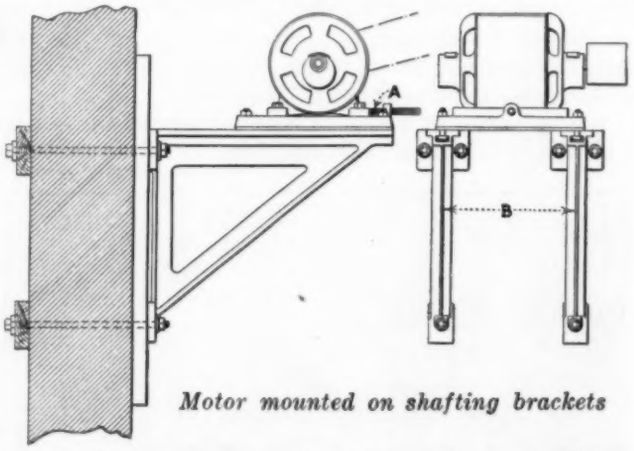
In threading pipe longer than could be swung between centers, the tailstock of the lathe was removed and a block of wood about 8x10 in., grooved on the bottom to fit the Vs and cut out on the top to the radius of the pipe to be threaded, bolted to the lathe bed. The outboard end of the pipe was supported by the block, while the other end was held in the chuck in the manner stated above. When the thread had been cut on the end next to the chuck, the pipe was turned end-for-end and the other thread cut.

An Easily-Made Support for a Motor

By W. A. Richards

A practical and economical support for mounting a motor can be made from two cast-iron wall brackets, commonly used to support pillow blocks for carrying line shafting along a wall. The brackets can be secured from any manufacturer or jobber of power transmission material.

This support can be used for any motor having a solid, sliding base. The standard 1$\frac{1}{8}$-in. brackets are



Motor mounted on shafting brackets

suitable for carrying a motor of any size up to 7$\frac{1}{2}$-hp. rating. The mounting of a larger motor would depend entirely on the ability of the wall or structure to which the brackets are attached, to carry the load.

One of the advantages of this support is, that after full adjustment has been secured on the belt-tightening screw *A*, it can be returned to its original position, the basebolts loosened and the motor moved back to take up the belt slack. This can be repeated until the stretch is all out of the belt.

The only dimension that must be taken into consideration while erecting this support, is dimension *B*, which must be the same as the center distance of the bolt holes in the base. This dimension can be accurately determined from the motor-specification sheet.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Drive Screws for Wood

Q. Can you tell me how drive-screws are made? Are they rolled between one movable and one stationary die, or made by some method that is not in general use?

A. Since we have never seen the process of making drive screws, we can not give you the details, though our impression is that they are rolled between dies. In such a process, both dies generally move, but in opposite directions.

High-Speed Steel

Q. We have a large quantity of screw-machine parts to make from bessemer screw-stock, and want to make the tools from high-speed steel. Can you tell us the best brand of steel to use for this purpose?

A. It would be impossible for us to tell you what brand of high-speed steel is best for the purpose you have stated, for the simple reason that we know that all the brands are being used with success. If any of the high-speed steels are treated as recommended by the makers, we do not believe you will find much difference in them.

Gear Reduction-Unit

Q. We want to connect a 40- to 50-hp. motor through flexible couplings to one of our machines. The speed of the motor is 1,750 r.p.m. and that of the machine from 1,450 to 1,525 r.p.m. Owing to the difference in speeds between motor and machine, it will be necessary to interpose a gear reduction-unit having a radio of about 17 to 15, between them. Can you tell us where we can get such a unit?

A. It is doubtful if there is any gear reduction-unit having the ratios referred to, on the market. It will probably be necessary for you to have one specially built to fill your requirements.

Trouble With Hardened Parts

Q. I have had two pins for pillar-press tools rejected on account of the finish. Our hardener claims that the pins should have been highly polished before being hardened. He says the scale formed in heating comes off from finely finished pieces more readily than from rough pieces, also that scale prevents the quenching water from cooling the steel, and results in uncertainty in hardening. Is he right?

A. We do not believe the scale on steel has anything to do with the hardening, nor do we believe the finish of the work has anything to do with removal of the scale.

In general, such parts as pins for pillar-press tools should be ground after hardening, and an allowance in size should be made for the purpose. If you are making the pins to size before hardening and expect them to be ready for use directly as they come from the hardener, you are not doing a first-class job. We advise you to grind the pins.

Keyseating Axles

Q. How can I lay out and keyseat the axle of a locomotive so the eccentrics will be in the proper positions?

After a new axle has been put in, we hold the eccentrics in place by setscrews until after the valves have been squared up, and then transfer the marking for the keyseats in the axle from the keyseats in the eccentrics. This means that the axle must be taken out for keyseating and then replaced, all of which takes time and labor.

A. We do not know of any method of accurately locating keyseats for eccentrics on locomotive axles, other than by trial, unless you have the builder's drawings to work from.

You can avoid taking the axle out of the engine after squaring the valves, if you leave the keyseating of the eccentrics for the final operations.

Put the keyseats in the axle as near the proper positions as possible, put the axle in place, clamp on the eccentrics, couple up the valve gear and square up the valves by the usual method. The location for the keyseats in the eccentrics can then be laid out from the keyseats in the axle.

Standard Toolpost Openings

Q. Can you give me any information concerning standard sizes of tool steel and toolposts that should be used on various sizes of lathes, planers, slotters and boring mills?

A. Unfortunately, toolposts of lathes have never been standardized, each maker being a law unto himself regarding sizes of openings for the tools.

Planers, slotters and boring mills are usually provided with clamps instead of toolposts for holding the tools. Such arrangements are of sufficient size as not to limit, within reason, the size of tool to be used.

Welding Cast Iron

Q. Can cast iron be welded by the "Thermit" process? I have used it for welding steel, but have had no success on cast iron.

A. Cast iron can be welded with "Thermit" specially prepared. There should be mixed with the regular "Thermit," three per cent of 50/50 ferro-silicon and twenty per cent of mild-steel punchings.

Cast-iron welds are harder to machine than welds in wrought iron or steel. Cast iron contains over three per cent of carbon and when fused with "Thermit" steel, forms a high-carbon steel at the weld. Such welds can best be machined by grinding.

Technical Abstracts

Machine Tool Issue of *Zeitschrift des Vereines Deutscher Ingenieure*

Issue of February 21, 1925

Review of American Practice

Prof. George Schlesinger begins this valuable review issue with a critical report on his observations in American machine shops. As the main trend he notices the strengthening of all driving parts, including the frame; then the use of chilled castings for guides and ways. Final milling of accurate supports may lead to heating and distortion, hence the best firms prefer planing.

Gears are mostly heat-treated. Often, however, they are also hardened and ground. Individual drive predominates, but step-cone drive is better for high speed as for light-metal work. Sliding, rather than swinging, gears predominate. It is felt that many firms provide unnecessarily complicated and expensive change gears. It is not necessary to make it possible for each tool to cover all possible kinds of work. Scraping of ways is still universal, although planing would give the necessary accuracy. In Germany grinding of chilled ways on large surface grinders is spreading, but was not found by the author in America. In many machine tool shops he feels that quantity production methods have been introduced before they are warranted, and that the firms are overtooled.

Automatic machines are being more and more developed as multi-spindle machines. With the aid of the hardest kind of bearing combinations and forced lubrication the speeds are being increased and the spindle diameters are being reduced by the use of milled splines so as to decrease friction losses.

Multi-tool lathes are replacing turret lathes and Stellite makes very high cutting speeds possible. The author believes, however, that the German Klopstock steels will compete successfully with Stellite, as they are much cheaper and less sensitive to impact. The author is impressed with the fact that grinding and polishing is merely a final finishing process after high accuracy has already been attained. He is likewise impressed with the extensive care and liberal dimensions bestowed on quantity production tools—also with the high prices paid.

He believes that the progressive assembly adopted by the Jones & Lamson Machine Co. would suit German conditions, since the daily production is only five to six machines even in very good times. The interdependence of routing and cost-accounting has not reached the height in America that it has in some German factories. The general use of travelling cranes is emphasized.

The author is astonished at the recklessness with which new equipment is acquired. Some old firms have very poor buildings, but the tools are of highest grade.

The article ends with some general considerations of the development of transportation and of die casting. It is to be continued.

Factory Organization and Machine Tools

Prof. A. Wallichs in Aachen gives an article under the above heading. While it undoubtedly gives much of value for German readers, the material is of a character too generally known in America to warrant abstracting.

Who Invented the Twist Drill?

Dr. Trautvetter investigates the origin of the twist drill very thoroughly and comes to the conclusion that this tool was invented by an unknown person in England in the beginning of the 19th century. It is possible, however, that the drill was "reinvented" by others who did not know of the early use. This seems to be true of Johann Martignoni, a Swiss who had moved to Germany in 1863, and of Stephen A. Morse in America. However, Dingler's Polytechnisches Journal as early as 1823 brings the news of twist drills brought by Jacob Perkins from America. The author however, thinks that they were used in England even before this time, although there is no certainty as to who actually invented them or where they were used first.

Scientific Shaping of Cutting Tools

Willy Hippler in Kiel claims that even Taylor did not properly clear up the question of the best shape of the cutting tool. Decided progress was made through the researches of De Leeuw and Klopstock. The former has shown that a variation of tip angle between 50 deg. and 75 deg. has little influence on the power consumption. Tip angles of 20 to 30 deg., however, result in great power saving, but the strength of the tool demands greater angles than this. Klopstock has found a way out. He arranges along the cutting edge a narrow surface having a small back slope, and behind this a sharp "excavation" having a large back slope. It should be emphasized that tests have not shown that a great power saving results from a change in back slope alone.

While this is not yet definitely settled, the assumption is that the power saving occurs only if the tip angle is reduced below 50 deg. by the change in back slope. The course of the chip is determined by the normal back slope, which is an angle in a plane at right angles to the upper lip surface and the bottom surface of the tool.

The article goes on and discusses the geometry of the cutting tool in great detail and finally gives some diagrams by means of which the relations of the various angles can be determined so as to obtain correct grinding.

Notable German Machine Tools

F. W. Huelle in Dortmund describes the following tools:

A boring mill and a milling machine of the Mammut Works in

Nueremberg; milling machines of the Saechsische Fraesmaschinenfabrik in Chemnitz; a milling machine of Haendel and Reibisch in Dresden; some saws and some surface grinders of the same concern; a planer of Louis Soest & Co. in Reisholz near Duesseldorf; a key-seating or splining machine built by Schuchardt & Schuette in Berlin; a planing machine for spiral bevel gears of the Saechsische Fraesmaschinenfabrik in Chemnitz. The tools in this last machine run in circular arcs. The same simple planing tools are used to plane all gears of the same pitch.

The machines described are illustrated by excellent drawings. Without these a reproduction is hardly possible.

Investigations of Metal Cutting in the Lathe

Dr. Eng. H. Klopstock reports on research carried out at the Technological Institute in Charlottenburg on metal cutting in the lathe. The metals tested were cast iron, wrought iron and chrome-nickel steel. A very careful study of the various power losses in the gear box of the lathe were first carried out. It was found that the friction losses of the various shafts and bearings amounted to a maximum of 17 per cent exclusive of gear-tooth losses. The losses increased slightly with the ratio of cutting depth to feed. Three steels were used, two pointed and one cutting with the side. It was found that the radius of curvature of the point had to be at least 3 mm. in order to make it stand up in the proper manner.

The feed was carried out with the aid of a special motor so that the force necessary for feeding could be determined separately. It was found that the curves for feed pressure and turning force did not vary much from tool to tool. In general, the force per sq.in. did not vary greatly with the chip area. Especially for chrome-nickel steel a slight rise is noticeable for very small cross sections.

By comparison it was found that a close relation obtained between the area of indentation and the force on the ball in Brinell hardness tests on the one hand and the chip section and cutting force on the other. By plotting the two kinds of curves on logarithmic paper and using the plot as a basis for interpretation it is found that one can by means of a single indentation test on a workpiece determine the relation between chip area and cutting force for this piece.

In general it was found that planing chips and turning chips are of the same character. It is easier to study the details of the cutting in the planer than it is to study them in the lathe.

Water cooling has no other influence than to increase the life of the tool, or make possible a higher cutting velocity.

The article is to be continued.

Automatics

Chief Engineer Ph. Kelle describes a number of automatic lathes that now are finding increasing application in Germany. It appears that the majority of these are developed after American patterns (Acme, Gridley, Brown & Sharpe, etc.). For heavier work the Gridley type is becoming steadily more popular. The reason is the positive way in which the tools are supported by this type of machine.

Machine Tools in Ship Building and Large Machine Tools

The last articles are a rather extensive review of the tools used in ship building and of the progress in the manufacturing processes and methods of handling some of the large machine tools.

Controlling Production

H. S. Riggs of the Lodge & Shipley Machine Tool Co., gives in detail the important factors of the control system used in this plant. The entire course of an order is traced through the shop from the time it is received until it is shipped complete. Forms are illustrated to show how the control is effected and how this method facilitates the management of each of the departments.

One of the important factors in this system is the "Move Station." To facilitate the flow of work through the shop, regular stations are marked off in each department for all material which that department has just received or is finished with. Any material found in the move station is to be taken first to the inspection department and then to the next department as specified on the traveler tag that accompanies the job.

As soon as a foreman places any work in the move station his responsibility for it ceases. It is then up to the trucking system to see that it is moved promptly. Before the next operation is done the material is taken to an inspection department and all of the work carefully inspected. The traveler tag is punched by the inspector opposite the work just inspected. The job is then set in the move station of the inspection department and taken to the receiving station of the next department specified. In this manner the arteries of traffic are kept open at all times and a supply of work always kept on hand in each department.—*Management and Administration*, March, p. 253.

A Special Milling Machine for Making Punch and Press Dies

Engineer Brandl describes in *Die Werkzeugmaschine* a seemingly very flexible little milling machine for the manufacture of punch and press dies. Fundamentally, the machine consists of a horizontal chuck and headstock driven by a pulley, and a work support or cross-rail, with its face in a vertical plane, and T-slots running horizontally. This cross-rail is located below the headstock. It can be swung around by an indexing dial and it can also be raised or lowered vertically. Various extension arms, vises or work holders can be bolted to the rail. By using either drills or milling cutters in the chuck and by either feeding the work vertically or horizontally or by swinging it around, a great many operations can be performed very expeditiously and with as much accuracy as by any other method.

Six illustrations serve to make clear various processes for which the tool can be used.—*Die Werkzeugmaschine*, Jan. 30, p. 25.

Grinding Knight Motor Parts

This describes generally the work of the eccentric shafts. The body of the shaft is turned all over and then rough ground on a plain grinding machine, equipped with a manufactured corundum wheel, 20 in. in diameter, with a 2½-in. face, 24 combination grit, N. grade, vitrified bond. This wheel is operated at an approximate peripheral travel of 6,000 ft. per minute. The shaft is 22 in. long and at this stage of operations 2$\frac{3}{32}$ in. in diameter. Approximately 0.025 in. of material is removed and the production is 250 shafts in nine hours.—*Abrasive Industry*, April, p. 111.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

A Change for the Better

THE recent announcement of a change in the method of procedure of the Federal Trade Commission marks a distinct advance on the part of that generally unpopular organization. Hereafter complaints will not be issued against parties until they have had a hearing, a chance to explain.

Under the old rule a complaint was issued whenever the Commission decided there was just cause. In many cases the complaints could not be sustained and were dropped. But the damage had been done to the defendant's business and there was naturally no redress. Now, the respondent at least has the opportunity to show cause why the complaint should not be issued.

Another improvement rests in the interpretation of the "public interest" clause. Where it is obvious, from the fraudulent nature of the business, that the public interest suffers, the old procedure will continue. Other cases will be settled by stipulation, a much more expeditious and economical method.

Standardizing Milling Cutters

THE meeting of cutter manufacturers and users, held recently in Washington by the Division of Simplified Practice of the Department of Commerce, was typical of the sensible manner in which Secretary Hoover and his corps of assistants are endeavoring to assist both manufacturers and consumers in various lines of industry. Pointing out economies that have been effected in other lines of industry, conferences are called of the various classes concerned, and they are assisted in arriving at tentative suggestions for the elimination of unnecessary sizes.

There is no semblance of paternalism or of regulation. The Division of Simplified Practice merely acts as a clearing house by assisting in the orderly collection and classification of data and in the bringing together of all interested parties for conference and, if possible, agreement on a tentative program. Some people, who are always scenting trouble in any governmental activity, raise the bugaboo of a standardized world in which individuality is submerged and everyone lives in a monotony of deadly, unvarying routine.

Nothing could be further from the ideas or desires of either Secretary Hoover or his assistants. They realize that standardization is an excellent slave but a very undesirable master; that while it is necessary for everyone on the road to turn out the same way for the safety of all, the kind of a car he drives is a matter to be settled by personal taste and economic considerations. They oppose the idea of standards that cannot be changed whenever conditions make it desirable and suggest that, when adopted, they shall be for a year or some other pre-determined period. With the feeling of restraint or finality removed, the users of a standard consider its advantages and disadvantages, and change whenever necessary.

Instead of being a bar to progress it really aids in developing new ideas along rational lines. For with the best ideas of current practice brought together in a tentative standard, a good opportunity is presented for concentrating invention on the problem of getting something better, rather than merely something different.

It Pays to Use Modern Equipment

A FRIEND has just directed our attention to an analysis of the statement of the U. S. Cast Iron Pipe and Foundry Co., as a fine example of the profits to be made with modern equipment. In the analysis, which appeared in the Wall Street Journal, emphasis is laid on the fact that the common stock of this company had always been a safe bet for short selling when it climbed as high as 40 until 1923 when the earnings were $21.92 a share.

The big jump in earnings followed the successful institution of the centrifugal process of casting pipe, a process that involved an extensive equipment installation. That the 1923 profit was no flash in the pan became evident when the 1924 figures of $43.17 a share were published. No better example of the profits to be made from the use of the most modern equipment has come to our notice in a long time.

Support for Scientific Research

ELSEWHERE in this issue is an article describing the valuable research work on fatigue of metals that is being done at the Illinois Engineering Experiment Station. Very useful results have already been secured but there is still much to be done. For instance, no funds are available for an investigation of the resistance of steel castings to fatigue stresses.

Two or three national organizations such as the Engineering Foundation and the National Research Council have helped to finance the work done so far, and several of the most progressive industrial corporations have likewise contributed. There are many others, however, that could benefit greatly from a more exact knowledge of the physical laws governing fatigue. It seems only fair, therefore, that they should bear at least a portion of the burden of the expense.

Shop Equipment News

Blodgett "Buhr" Multi-Head Drill Press No. 2P

A number of changes in design have been made by the Blodgett Engineering & Tool Co., 14th & Dalzelle, Detroit, Mich., in the design of the multi-head machine developed originally by the J. F. Buhr Co., and previously described on page 940, Vol. 61, of the *American Machinist*. The machine illustrated in Fig. 1 is being built and marketed for high-production multiple drilling and tapping.

The upper frame and main spindle are designed to accommodate a stationary multiple spindle head, or to drive an adapter head to which a number of workheads may be attached.

The table is made in two parts, the upper operating on four bronze bushed guide posts in the lower, and carrying the work-holding jigs. The lower part is adjustable on the machine column through a range of 10 in., and is designed to be clamped to the column in a stationary position. A cam and roller combination, driven through a set of pick-off feed-change gears, are inclosed in the lower part of the table to raise and lower the upper section. The cam

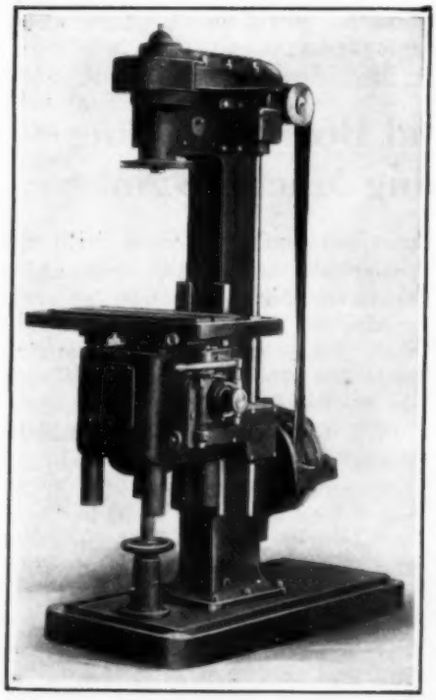


Fig. 1—Blodgett "Buhr" Multi-Head Drill Press No. 2P

Fig. 2—A special multi-spindle head and index table fitted to the machine

is fashioned for rapid approach and retreat and in connection with the change gears provides feeds ranging between 0.000,5 and 0.032 in. per revolution.

A handknob on the right-hand side of the lower table-section can be turned to lock the clutch for continuous operation, or can be set to cause the table to stop at the bottom after completing one cycle.

The driving spindle is 1.574 in. in diameter, is made of chrome-nickel steel, heat-treated, and runs on taper roller bearings. The drive and idler pulleys are designed with ball bearings. All gears and the table cam operate in grease.

In addition to the regular table the machine can be equipped with an index table so loading may be carried forward while the spindles are working. One of these tables is illustrated in Fig. 2, where an index and jig are shown which are being used in the Brandes Co. for drilling and counterboring head phones.

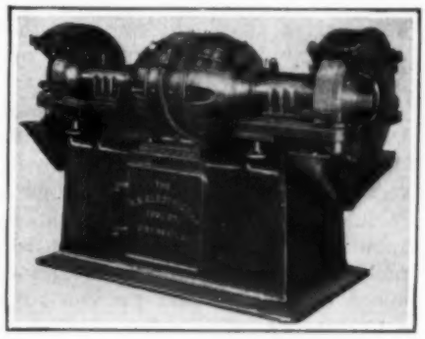
Special heads, tables, work jigs, etc., are subject to specification for any given work.

From center of spindle to face of column is 9½ in., from spindle to base is 56 in., and from table top to spindle measures 26 in. The length of table-feed is 5 in. The normal spindle speed is 450 r.p.m., which can be increased on the belt-drive machine to 1,500 r.p.m. The floor space occupied is 38x52 in., and the machine, which requires a 5 to 10-hp. motor, depending on the speed desired, weighs 2,000 lb.

U. S. Constant-Peripheral-Speed Grinder

A double-end grinding machine has been placed on the market, in addition to its other lines, by the United States Electrical Tool Co., 2488 West Sixth St., Cincinnati, Ohio, that has been designed to maintain a constant peripheral velocity at the surface of the grinding wheel by provision for increasing the speed of the d.c. driving motor as the wheel is worn down. The purpose of the design is to increase production by maintaining the proper grinding speed, regardless of the wheel diameter.

The wheel guards are mounted on gibs that can be moved back as the



U. S. Constant-Peripheral-Speed Grinder

wheel wears down, and are attached to a resistance control to the motor that causes it to change speed as the guards are moved.

The motor is totally inclosed, of the 40-deg. rating and is push-button controlled. The spindle is in one piece, made of nickel steel and is mounted on four heavy-duty SKF ball bearings.

SHOP EQUIPMENT NEWS

Kent Capscrew-Pointing and Shaving Machine

The Kent Machine Co., Kent, Ohio, has purchased all of the rights in connection with an automatic machine that has been developed by the National Acme Co., Cleveland, Ohio, for shaving and pointing capscrews and is manufacturing it for the market.

The machine, which is illustrated in two views, front and rear, is equipped with magazine feed and is belt driven, but can be furnished when desired with motor drive and hopper feed.

It is intended for handling upset-head bolts, capscrews and similar parts, and has a capacity range for work between $\frac{1}{4}$ and $\frac{5}{8}$ in. in diameter inclusive, by $\frac{3}{4}$ to 4 in. in length. By combining operations that were formerly done in two machines the speed of finished-part production is considerably increased.

The magazine is adjustable to hold the various sizes of screws by their heads and to guide them as they feed into the machine by gravity. At the bottom of the magazine a pusher rod moves the work into a workholder which carries four chucks that are indexed at the proper time by a fan gear. These chucks are split and held by bolts and springs which are arranged to hold the two parts open a limited amount until the work is inserted. A cam-operated gripping mechanism closes the halves against the spring action to hold the work by its head during the pointing operation.

There are four positions of the workholder corresponding to its four chucks, load, point, idle and transfer. After indexing from the third or idle position, a cam-operated transfer head grasps the workpiece while a pusher rod, also cam operated, pushes it from the holder into a revolving chuck carrying the transfer head along with it. The chuck has an inside, adjustable stop to locate the work in position to line up with the facing tools. After the piece is in the chuck the transfer head and pusher rod are drawn back and the chuck is closed. The tools are then advanced for the shaving operation and withdrawn, when a spring-operated rod in the chuck spindle ejects the finished piece.

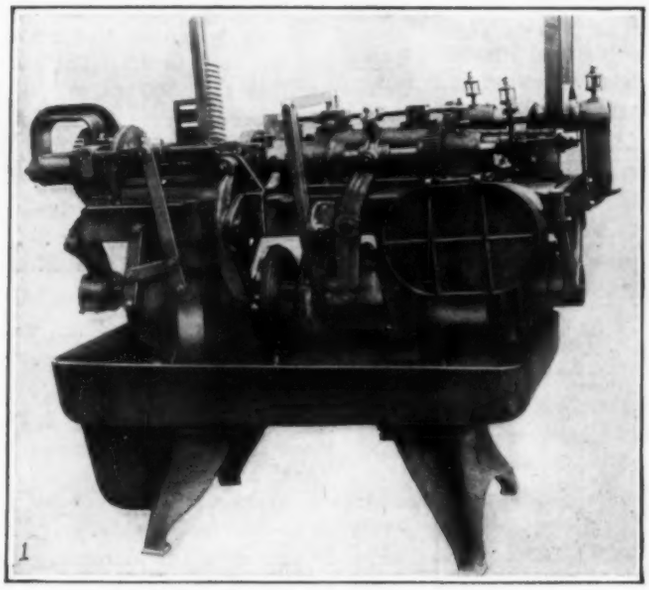


Fig. 1—Kent Capscrew-Pointing and Shaving Machine.

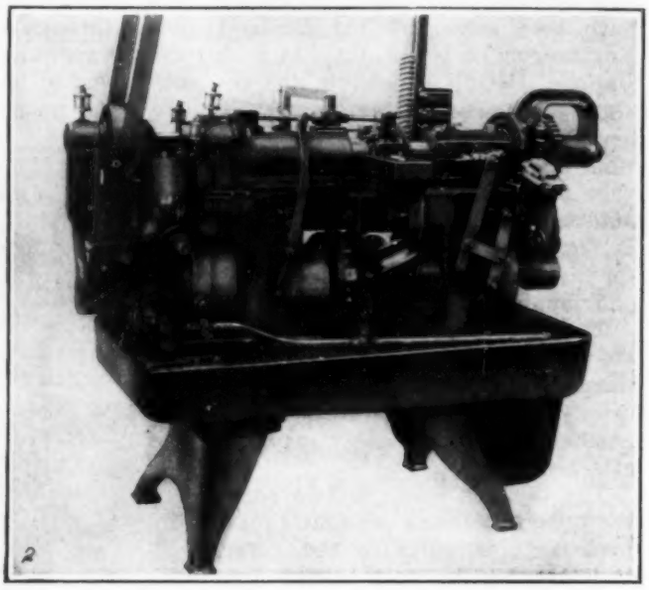


Fig. 2—A rear view of the machine

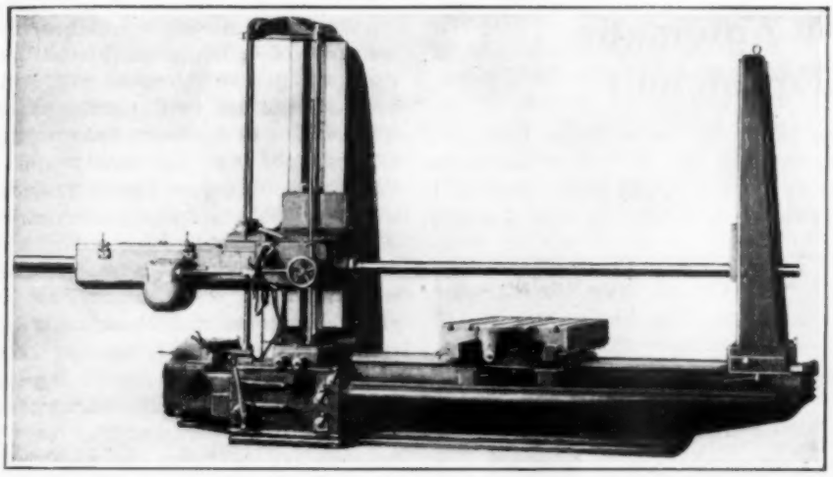
Defiance Horizontal Boring, Milling Drilling and Tapping Machine No. 6

To increase the range of its line of standard, horizontal boring mills the Defiance Machine Works, Defiance, Ohio, has added the No. 6 machine illustrated. It embodies all of the features of the regular line increased in size commensurate with the larger work for which this size is intended.

The head, feed and speed boxes are of unit construction and totally inclosed, the gears running in oil. Spindles in the latter two boxes are equipped with Hyatt roller bearings. A continuous gravity system is used at all other points requiring lubrication. The control levers are centrally grouped and include one that governs the direction of rotation of the main spindle. Rapid traverse is provided and interlocked with the power-feed movements. As an added provision for continuous, accurate production, the platen is designed with rollers under its overhanging ends that ride on hardened-steel rails on the bed.

The $4\frac{1}{2}$-in. spindle has a maximum horizontal travel and a vertical adjustment of 60 in. the latter bringing it to a maximum of 60 in. above the top of the platten or $70\frac{1}{2}$ in. above the bed. The maximum distance from the face of the spindle to the face of the tailblock is 9 ft. and 6 in. A 64-in. cross-feed is provided for the 36 x 64 in. platten. The boring bar regularly furnished measures 4 x 92 in. There are 10 speed changes ranging from $7\frac{1}{2}$ to 157

SHOP EQUIPMENT NEWS



Defiance Horizontal Boring, Milling, Drilling and Tapping Machine No. 6

r.p.m. and 12 feeds for spindle, spindle head, saddle or platen from a minimum of 0.004 in. to 5 in. per revolution of the main spindle. A 10 hp., 900 to 1,200-r.p.m. motor is recommended for the drive, the machine being properly geared for speeds between these two limits.

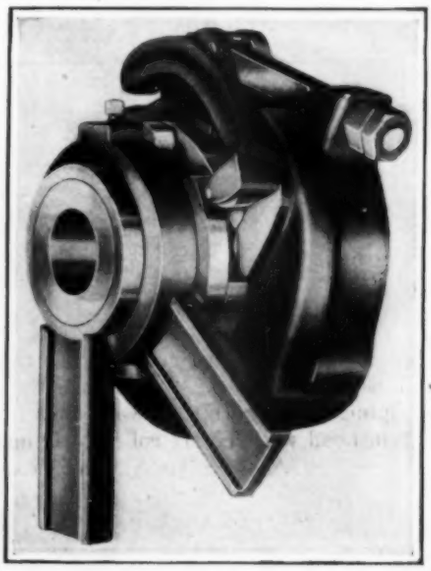
The length of bed or dimensions of the platen can be altered as desired and additional equipment, consisting of vertical milling attachment, star-feed facing head, auxiliary tables and the regular table with either plain or circular swiveling design are subject to specification. The machine as shown weighs 30,000 pounds.

Conway One-Revolution-Stop Clutch

The range for application of its clutches has been increased by the Conway Clutch Company, 1940 West Sixth St., Cincinnati, Ohio, by the addition of a clutch which can be controlled to release after a fraction, one, or a measured number of revolutions have been made, and by the adaption of its standard compression clutch to general shop equipment uses.

The one-revolution-stop clutch, illustrated in the engaged position, is a standard design with the addition of two cams, in the place of the regular cone, and a corresponding change in the friction lever to carry a roller which rides on both cam surfaces engaging the clutch, or falling into the depression formed when the cams are rotated till their cut-outs coincide.

The cams ride free on the hub of the clutch and are controlled by means of the projecting levers shown. The end of the vertical lever which is fitted on the extending hub of the inner cam is secured to it by a set screw and is fastened to a stationary part of the machine on which the clutch is mounted, thus holding this cam in a set, stationary position. The other lever which is integral with the outer cam, riding free on the hub of the inner one, is attached to a treadle or to a hand control conveniently located. When this control is in the "off" position the depressions in the cams coincide and the lever wheel drops in as it comes around, thereby releasing the clutch.



Conway One-Revolution-Stop Clutch

Operating the control, with reference to the illustration, in a counter-clockwise direction, forces the lever wheel up and engages the clutch. As long as the outer cam is held in this position, forming a continuous circular path in connection with the inner cam, the clutch is in operation.

It is built in nine sizes that, based on 100 r.p.m., will develop from 3 to 20 hp. On the largest, 90 r.p.m. is rated as recommended maximum while this figure is set at 150 r.p.m. on the smallest size.

The standard compression clutch has not been altered in its essential features and is available in fourteen sizes that will transmit from 1 to 35 hp. at 100 r.p.m. Some of the smaller sizes can be operated considerably faster. Both styles can be furnished with extended sleeves when desired.

Buffalo Repair Forge No. 236

The Buffalo Forge Co., Buffalo, N. Y., has added a forge having a one-piece steel hearth to its regular lines. It is designated as No. 236 of a series and is intended for use on repair work.

The hearth is approximately 6 in. in depth by 24 in. square and is

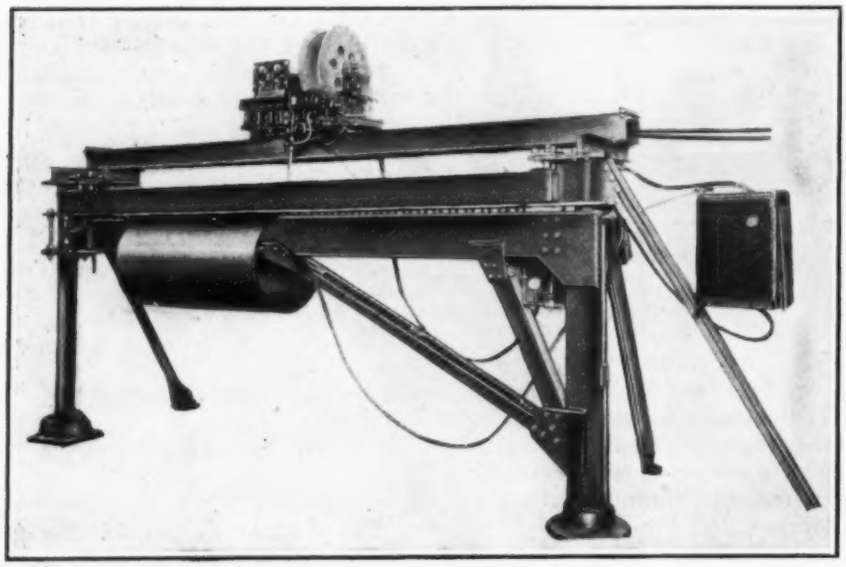
Buffalo Repair Forge No. 236

built with a wide flange around the edge to withstand the usually severe service to which repair equipment is subjected. With this one piece construction eliminating all seams, corrosion is not a serious factor. The angle-iron legs and cast-iron fireport, are not altered from standard. The forge is designed for use with hand-operated or electric blowers in various sizes. It weighs 180 pounds.

SHOP EQUIPMENT NEWS

General Electric Automatic Arc-Welding Equipment

An equipment consisting of an automatic arc-welding head and a suitable work-holding fixture, over which the head is arranged to move, automatically by a motor connected across the arc to follow its variations closely. Push-button control is conveniently located for the operator.



General Electric Automatic Arc-Welding Equipment

has been developed by the General Electric Co., Schenectady, N. Y. It is being marketed for quantity-production work on such products as tanks, boilers, cams, axle housings, pipe and various storage vessels where the static load does not exceed 10 lbs. per sq.in., and where metal thickness is at least 16 gage. It is also adaptable for building up undercut shafts, adding metal to worn flanges on carwheels and similar repair work.

The work-holding fixture is made in each case for the work in hand, the illustration showing one for welding a longitudinal tank seam. Here the head is mounted on a channel track above a pivoted work-holding arm. In position for welding as shown, the arm is clamped tightly against the work by means of pneumatic clamps. The fixture illustrated will take care of work up to 10 ft. in length on a minimum diameter of 13 in. and a range in thickness from 16 gage to ¼ inch. It is said that production can be greatly increased over hand methods by using this machine with two men.

The welding wire is carried on a reel on the head and is fed down

A complete equipment consists of a head and control panel, a travel carriage and a clamping device.

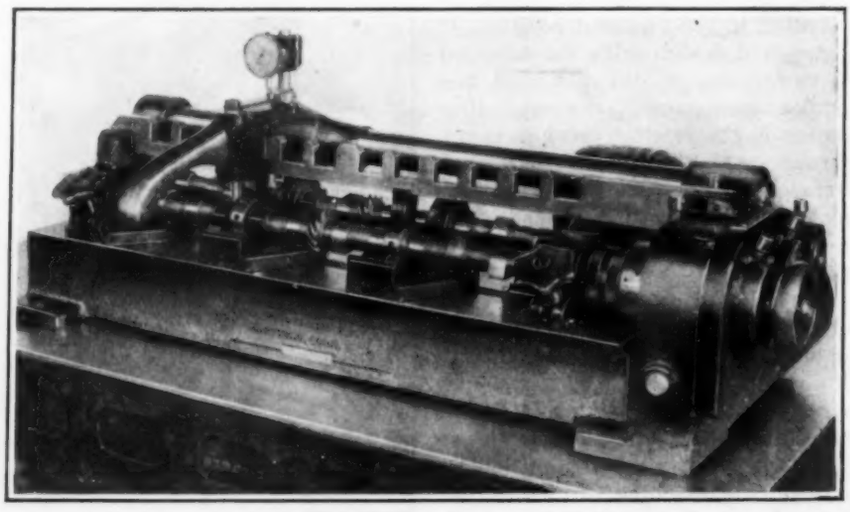
Pratt & Whitney Automobile-Camshaft Comparator

The Pratt & Whitney Co., Hartford, Conn., has brought out a device for testing the accuracy of camshafts for automobile motors. It consists of a rigid cast-iron base upon which are mounted a driving head containing two spindles, bearing blocks to support the regular bearings of the camshaft, and a sliding comparator head provided with a suitable indicating mechanism.

The bearing blocks at both ends of the respective shafts are provided with swinging caps to inclose the shaft bearings, and these caps are secured to pivoted bolts and hand nuts so that no time need be lost in changing work. The outer-bearings support, corresponding to the tailstock of a lathe, is adjustable along the base to accommodate any length of camshaft within the range of the device. The intermediate supports are open at the top and are also adjustable lengthwise of the base to conform to the positions of the camshaft bearings.

The spindles are rotated in synchronism through two sets of helical gears inclosed within the headstock housing and running in oil. One of the driving gears has a slight endwise adjustment along its shaft for the purpose of compensating for any relative angular advance of one spindle over the other because of wear. Power to drive the device is supplied by a ½-hp. motor located on the base behind the headstock. The motor pulley is belted to the first gear shaft, and the speed reduction is so calculated as to drive the spindles at the proper speed to permit adequate observation.

Each spindle is provided with a spanner-operated chuck having a



Pratt & Whitney Automobile-Camshaft Comparator

SHOP EQUIPMENT NEWS

keyway to match the permanent key of the camshaft. The chuck shaft of the front spindle is driven through a friction that is tightened by means of the small handwheel to be seen at the right of the device in the illustration. This permits the camshaft under test to be rotated freely by hand to determine if the angular advance of the first cam with relation to the locating key is within the permissible tolerance. The variation, if any, may be read directly from graduated collars on the spindle.

The comparator head is made to slide along a rigid, round bar mounted above and parallel with the camshaft. In front of this supporting bar is a notched gaging bar of rectangular section which shares the duty of supporting the comparator head, and also locks it against endwise movement. By grasping the projecting handle, the head may be tilted back to lift it out of engagement with the notch in which it rests when it may be moved along the round bar to whatever position may be required and again dropped into engagement at a notch at that point. The notches of the gaging bar correspond with the locations of the cams upon the camshaft to be tested.

The method of using the device is to place a master camshaft, known to be accurate in contour and angular relation, in the spindle at the rear and a shaft to be tested in the front spindle, slide the comparator head to a position over the first cam and drop it into the corresponding notch of the gage bar.

In the head are two plungers, each with a roll at its lower end, so located that one plunger rests upon the first cam of the master camshaft and the other upon the corresponding cam of the camshaft under test. One plunger carries at its upper end a dial indicator, clamped to and moving with it. The other plunger carries a flat bar, extending back to and under the measuring spindle of the indicator.

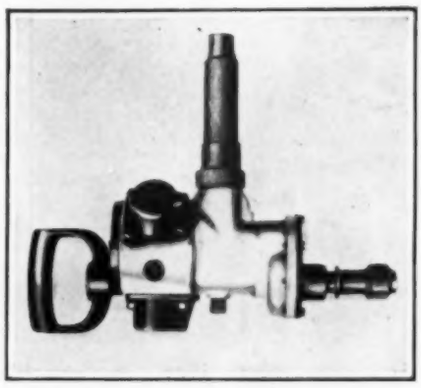
The master camshaft is turned until the roll of its plunger rests upon the apex of the cam. With the friction loose, the shaft under test is turned by hand to the same position and the friction locked. The position of this cam with relation to its keyway is then shown by the graduated collars, which, if the shaft is correct, should read zero. The dial of the indicator is also set at zero.

The motor is started and the plungers move up and down in unison, actuated by the cams below them. If they are exactly alike in every respect, there will be no movement of the indicator pointer over the dial for the reason that the relation between the end of the measuring spindle and the indicator itself is not disturbed even though both are moving through a distance determined by the throw of the cam. If a difference exists, this relation will be disturbed and the amount of variation may be read directly from the dial in thousandths of an inch.

Ingersoll-Rand Pneumatic Wood-Boring Drill Size "DD"

A reversible pneumatic drill suitable for drilling in wood up to 1 in. in diameter has been added by the Ingersoll-Rand Company, 11 Broadway, New York, N. Y., to its lines of similar equipment.

The construction is essentially the same as in the other sizes manufactured by the company as pertains to the 3-cylinder motor, the aluminum case with steel bushings for bearings and throttle cast in place, the renewable crank-pin sleeve, and the renewable and interchangeable cast-iron cylinders.



Ingersoll-Rand Pneumatic Wood-Boring Drill, Size "DD"

The rotating parts are accurately balanced and the drill is said to be economical in air consumption. Its average working speed is 705 r.p.m. It weighs 15 lb., and is 15 in. in overall length. It is provided with a feed screw which has a maximum travel of 2½ inches.

The drill is furnished with a spade handle and a bit chuck as standard equipment but these may be substituted for by a breast plate or feed screw and a drill chuck if the latter are preferred.

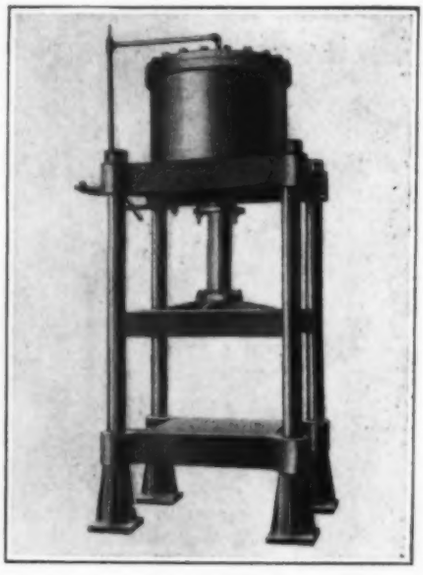
Barr Low-Pressure Hydraulic Press

A press designed for general-purpose work, operating on comparatively low pressure and short stroke, is being marketed by H. Edsil Barr, Erie, Pa.

The cylinder is 24 in. in diameter and sufficiently long for an 8-in. maximum stroke, operating at 200-lbs. pressure. The piston and rod are integral and made of cast iron. Bronze studs and nuts secure a follower ring against two packing leathers on the piston for double action. A conventional stuffing box is provided for the piston-rod fit in the cylinder head.

The upper platen is guided with babbitted shoes to the four steel columns and is secured to the piston by a split collar fitting into a groove at the base of the rod. The base is heavily ribbed and stands 12 in. in height.

A three-way Homestead cock is conveniently located for operating the press, admitting water at shop pressure to move the piston to and



Barr Low-Pressure Hydraulic Press

SHOP EQUIPMENT NEWS

from the work, and then air or hydraulic pressure from an outside source at 200 lbs. maximum pressure for making the hit.

The press is rated at 45-tons capacity and measures 30 in. between upper and lower platens when the stroke is up.

Pels Steel-Plate Billet Shear

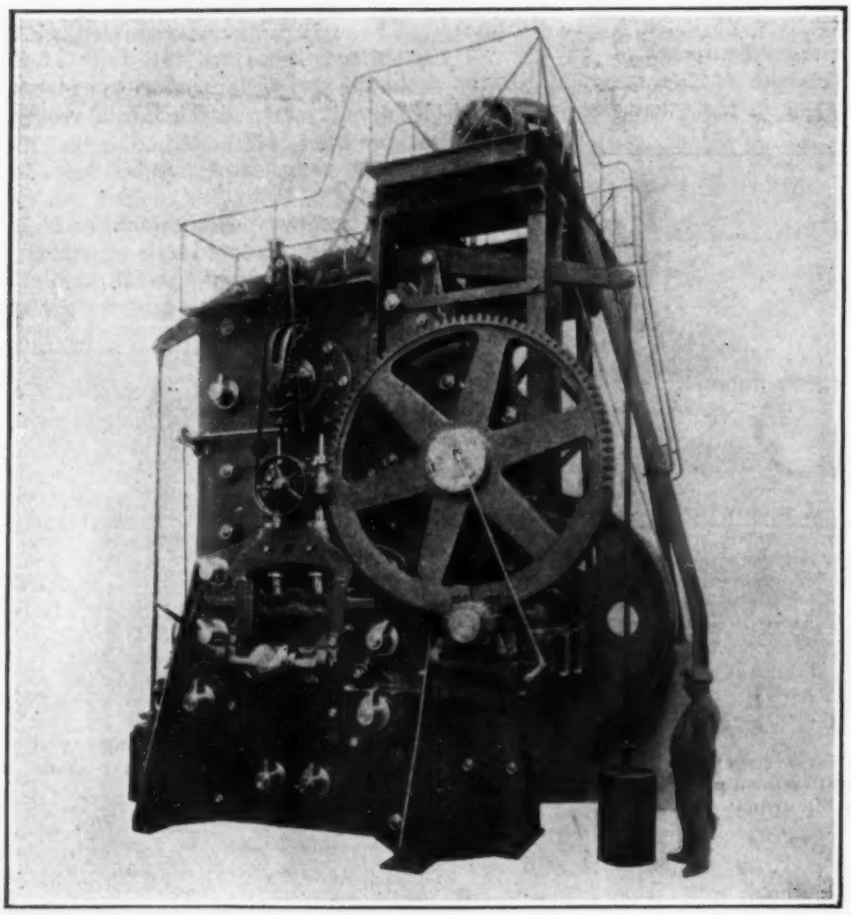
A fair idea of the size of the shear built by Henry Pels & Co., 90 West St., New York, N. Y., for cold cutting 9 in. rounds, 8 in. squares or 4½ x 20 in. flats, can be gained from comparison with the man standing at one side in the illustration. Its extreme height is 21 feet.

The frame of the machine is made of special, heat-treated armor plates. The 5-ton flywheel is made of cast steel. The main gear weighs 9 tons and is cut with 7 in. circular pitch. The upper cutting tool weighs 550 pounds.

Two motors are required. One of 100 hp. is mounted on top of the frame and belted to the main drive, while the other is connected by belt to operate the hold-down mechanism.

To make a cut the work is set and the hold-down operated to clamp it in position. A clutch is then thrown in by means of a control lever conveniently located. After the piece has been cut and the ram has returned to the top of its stroke, the clutch is automatically thrown out and the hold-down can be raised to release the remaining part of the billet. The hold-down is arranged so it automatically stops when it touches the work against which it is to hold and when it reaches the upper extreme of its travel as a means of guarding against jamming the mechanism.

The lower part of the machine is below floor level when it is set up to bring the tools to the proper level.

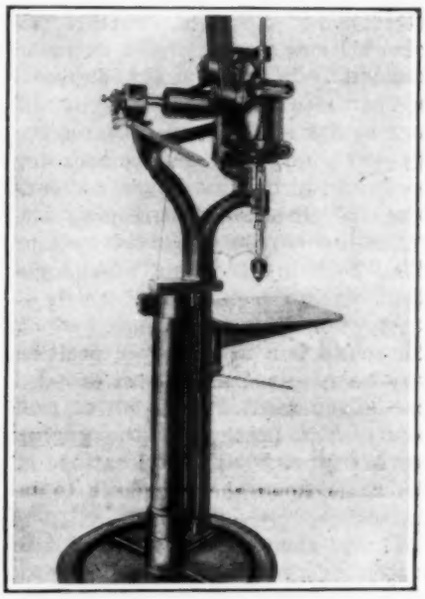


Pels Steel-Plate Billet Shear

Bartlett Friction-Drive Drill

The drilling machine illustrated has been designed by Leonard Bartlett, 39 Massachusetts Ave., Springfield, Mass., and is being built by the F. T. Daley Machine Works, 125 White St., Springfield, Mass. It is intended for general-purpose drilling and tapping and is designed to eliminate a number of standard drill-press parts.

The driving disk and shaft are mounted in a frame that can be



Bartlett Friction-Drive Drill

tilted in either direction out of horizontal by means of the lever attached to the movable bearing at the rear end of the shaft. The surface of the spindle-drive pulley is convex to match the movement of the disk so the point of contact will be progressively further away from the center of the disk as it is tilted. When the driving shaft is horizontal, a slight recess in the center of the disk allows it to clear the spindle pulley. The speed and direction of rotation can be set or altered by the position and movement of the control lever. The bearings are equipped with Bartlett oilless bushings. The table has a ratchet movement vertically and can be swung around the column to clear extra-long work. The machine can be built to specification sizes.

The control of direction and speed of spindle is said to be very flexible.

News of the Week

Ordnance Advisory Board Prepares for the Preservation of Peace

Judge Gary, General Tripp and others address meeting

Over a hundred manufacturers met Friday, April 3, at the Harvard Club in conference with the Ordnance Advisory Board, of which Judge E. H. Gary is chairman, to receive definite allocations of "tentative orders" for the production of artillery, rifles, machine guns, and ammunition in the factories of the metropolitan area. Upon accepting "tentative orders," factories will be designated as "Ordnance Reserve Plants," and will assume a status analagous to that of "Ordnance Reserve Officers" as now provided by law for individuals who volunteer their services for National Defense.

Among those present besides Judge Gary were John I. Downey, president of John I. Downey, Inc.; Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Co., and Col. James L. Walsh, chief of the New York Ordnance District.

Judge Gary, who presided at the meeting in his capacity as chairman of the Ordnance Advisory Board, welcomed the manufacturers who were present and pointed out that their attendance in such large numbers constituted an impressive response to the call of duty. Continuing, he said: "We should bear in mind that, with the exception of one regular Army officer who spends most of his time on this work, all of the other Government representatives with whom you are establishing contact are serving voluntarily —without pay—and I think we should remember that progress in our plans is very largely measured by the amount of time reserve officers can spare from their regular business pursuits.

Proper Planning Means Economy

"We are facing a tremendous problem. During the World War it was estimated that it would cost some thirteen billions of dollars to equip our first five million men with the arms and ammunition required to put them on an equal basis with the enemy. It is apparent that a considerable portion of this sum would have been saved by proper planning before the declaration of war. We have tried to take this lesson to heart, and we are now planning to meet this emergency, if one should unfortunately occur in the future."

General Tripp, in addressing the meeting, said in part, "This getting together of the War Department and manufacturers makes possible the doing of good work for the Nation under the best possible conditions, instead of forcing the turning out of bad work under the worst possible conditions. Especially it eliminates, as far as such a thing can be done, the fly-by-night manufacturers who upset markets, cornered supplies, pre-emptied labor, clogged transportation did poor work, and were the read profiteers during the late war.

"The best feature of the demonstration is," continued General Tripp, "that it does not constitute a challenge to any foreign nation. The only possible reply that even the most aggressive of our foreign neighbors can make to it is to initiate similar systems themselves. To this we would not have the slightest objection. We could see in it no danger to ourselves and would freely concede that it is not only their right, but their duty, to take such effective defense measures."

Candid Facts by Col. Walsh

Col. James L. Walsh, Chief of the New York Ordnance District on a dollar-a-year basis, cited official figures which showed that, in proportion to the population, the United States maintains the smallest standing army of any of the fifty principal countries of the world—our ratio of 124 soldiers per hundred thousand of population, being actually less than the 164 soldiers per hundred thousand which Germany is allowed to maintain under the terms of the Armistice—notwithstanding that it was thereby intended to render Germany impotent as a military power. Continuing, Colonel Walsh stated, "We are the wealthiest nation in the world —due largely to the sacrifices of those who have gone before us—yet we maintain but four soldiers per ten millions of national wealth, while Great Britain maintains forty, France seventy-three, Italy eighty-three and Japan one-hundred and eleven.

"In the light of history, we cannot expect to remain indefinitely weak, wealthy—and safe.

"The World War demonstrated that every other preparation for National Defense, including the building of airplanes, could proceed with greater rapidity than the manufacture of arms and ammuntion, which, therefore, sets the pace at which an effective military force can be put in the field. This being so, it is pertinent to ask whether our present plans place proper emphasis upon the ordnance phase.

Major-Gen. Charles P. Summerall, Commanding General, Second Corps Area, made the point that in the industrial phases of preparedness, no less than in the purely military phases, the impulse must come from the top; and congratulated the industrialists present upon the practical patriotism they had demonstrated in offering to co-operate with the War Department in an endeavor to effect a workable solution to the critical problem of matching our man-power with adequate munition-power.

February Exports of Machinery

Exports of metal-working machinery during February reported by the Department of Commerce are:

	February 1924	February 1925
Lathes	$88,780	$138,080
Boring and drilling machines	20,951	51,029
Planers, shapers and slotters	32,082	34,033
Bending and power presses	14,849	12,368
Gear cutters	20,887	98,980
Milling machines	35,021	44,018
Thread cutting and screw machines	53,889	32,807
Punching and shearing machines	8,908	5,793
Power hammers	6,009	12,657
External grinding machines	49,763	145,982
Internal grinding machines	14,284	5,870
Other grinding and sharpening machinery	25,232	31,493
Chucks for machine tools	35,314	18,950
Reamers, cutters, drills, taps, and other metal-working tools	153,532	186,164
Pneumatic portable tools	66,593	76,385
Foundry and molding equipment	16,455	42,096
Other metal-working machinery and parts of	349,271	366,695
Total	$991,820	$1,303,400

Merchandising Base of Westinghouse at Mansfield

All merchandising activities of the Westinghouse Electric & Manufacturing Co. henceforth will be directed from Mansfield, Ohio, instead of from New York and East Pittsburgh, the company has announced, adding that the desirability of the change has long been recognized as a means of obtaining unified effort.

J. S. Tritle, manager of the merchandising department, will become general manager of that department, and has moved his headquarters and staff from New York to Mansfield. Most of the articles in the merchandising department are produced at the Mansfield works, and the manufacturing, engineering and sales forces located at that point will report direct to Mr. Tritle.

Heretofore the engineering and manufacturing operations have been supervised by officers located at East Pittsburgh, while the sales activities have been directed from the New York merchandising headquarters. Under the new plan those engineers at East Pittsburgh who have been engaged on the products made in Mansfield will be moved to the Ohio plant.

Elaborate Plans for Foreign Trade Meeting in Seattle

Delegates from many countries will attend June convention

The call and preliminary program of the Twelfth National Foreign Trade Convention to be held at Seattle, Wash., June 24, 25 and 26, which have just been issued by James A. Farrell, chairman of the National Foreign Trade Council, reveal an advanced state of plans for what is to be the Council's first comprehensively international convention.

Delegations of business men have accepted the Council's invitation and will come to Seattle from Japan, China, India, Straits Settlements, the Dutch East Indies and the Philippines. They will take an important part in the group sessions on the practical phases of foreign trade, which will cover such vital matters as credits and credit information, selling methods, packing, shipping, documentation and finance, and advertising. As announced by the Council's headquarters in New York, group sessions will be held on American foreign trade problems in each one of these Eastern nations, and at least two of the speakers will be business men from the country under discussion.

The delegations from the Orient were invited by a special mission of the Seattle Chamber of Commerce which returned from a successful six weeks' journey to the Orient on March 17, and reported that the Council's invitation has aroused wide interest in the Far East and will result in substantial and representative delegations from each of the countries mentioned.

An additional group session of special interest in view of the improved conditions under the administration of President Calles of Mexico will be devoted to the republic of Mexico.

Although stressing new American opportunities in Oriental trade, the Twelfth National Foreign Trade Convention will be as heretofore a forum for the discussion of the most general and the most vital interests which all Americans have in the $8,201,534,524 worth of foreign trade done in 1924. An annual American production of more than $70,000,000,000 stands behind this foreign trade, finding its own outlet and its exchange for world products a vital necessity of our economic system.

This Year's Business

Last year, declares Mr. Farrell in his call to the convention, the volume of American foreign trade exceeded 92,000,000 tons, or more than 252,000 tons for every day in the year. This immense volume of business comprised 49,200,000 tons of American products exported to all the countries of the world; and 42,800,000 tons of foreign materials imported into the United States to serve the needs of our industries and our people.

"This year," declares Mr. Farrell, "gives promise of exceeding 1924. There is a new assurance of stability and progress in Europe, where steady improvement has been made for the last six years. There is increasing activity in the countries across the Pacific, as well as in South America and overseas markets. American foreign traders have seldom, if ever, faced a more hopeful outlook."

The Trade Adviser Service of the Convention, conducted by a representative and expert group of trade leaders who are available for informal advice on foreign trade practice under modern practical conditions, will be repeated this year. This famous "experience service," conducted by seasoned foreign traders, has acquired a unique value at National Foreign Trade Conventions. There will also be group meetings of export, sales and credit managers, exporters and importers, foreign department executives of banks, and educators, so as to furnish special opportunity for business men of common interests to profit by the convention sessions.

Three special trains, making sleeping car connections with all Eastern and Central cities, are scheduled to leave Chicago for the Convention by the Great Northern, Chicago, Milwaukee & St. Paul, and Northern Pacific railroads. The cities of the Pacific Northwest, led by the Seattle Chamber of Commerce, have made special arrangements for business and sightseeing tours to present an object lesson to the rest of the country in this area, whose population is growing at five times the rate of the rest of the United States and whose foreign trade, in the Washington customs district alone, has increased from $175,000,000 to $426,000,000 in the last four years.

Coffin Foundation Awards

Forty-three employees of the General Electric Co. have received Charles A. Coffin Foundation awards for having made most signal contributions toward the increase of the company's efficiency or progress in the electrical art during 1924. Twelve of the prizes were won by shop men, five by foremen, fifteen by engineers, and seven by commercial men. Four special awards were made for the presentation of papers at company meetings. With each certificate of award there is a prize of $250.

Schenectady employees received sixteen awards, Lynn eight, the Edison and National lamp works four each, and Pittsfield three. Philadelphia, Buffalo, Erie, Minneapolis, New York, Salt Lake City, Chicago and San Francisco office employees received one each.

The purpose of the employees' awards, established by the board of directors of the General Electric Co. in 1922 as an expression of the appreciation of the company for the work in the electrical industry of its founder, Charles A. Coffin, is recognition for unusual service rendered by employees in their work. All employees have equal chances—the work of the shop man is not compared with that of the engineer, but with that of other shop men. One class does not have preference over another.

One of the most interesting of the cases was that of R. S. Nassif, an oven tender at the Pittsfield works. His suggestion, that a conveyor system be installed, eliminated his job, as he knew it would; but he was given another and better one.

John Flaws, Jr., an experimental machinist at the Edison Lamp Works, received a prize for developing a machine for producing radiotron tube filaments of greater accuracy and more efficiency. It is interesting to note that he also received an award last year, following his development of a more accurate and more economical machine for winding the grids of vacuum tubes.

H. T. Plumb, an engineer of the Salt Lake City office, was very active in rescue work during the Castle Gate mine disaster in Utah. His humanitarian service won for him one of the awards.

Pittsburgh Will Have Machine Tool Exhibit

An exhibition and demonstration of machine tools will be given by the Motch & Merryweather Machinery Co., at the Pittsburgh office, 130 Seventh St. The dates set for the show are April 17 to 25, and from announcements sent out the demonstration will be exceptional in many ways.

Like other exhibits that have taken place this year in various parts of the country, no "trick" jobs will be undertaken, but the working on all machines will approximate actual conditions in industrial plants. Altogether there will be exhibited between seventeen and twenty machines and each of the factories will be represented by sales engineers and demonstrators.

The following concerns will be represented and their products demonstrated:

The American Tool Works Co., Cincinnati, Ohio.

Baker Bros., Toledo, Ohio.

The Bullard Machine Tool Co., Bridgeport, Conn.

The Cincinnati Milling Machine Co., Cincinnati, Ohio.

The Cochrane-Bly Co., Rochester, N. Y.

The Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

Gould & Eberhardt, Newark, N. J.

The Keller Mechanical Engineering Corporation, Brooklyn, N. Y.

The V. & O. Press Co., Hudson, N. Y.

Union Steel Buys Two Other Companies

Officers of the Union Drawn Steel Co. announced recently that plans had been completed to absorb the Peerless Drawn Steel Co., Massillon, Ohio, and the Standard Gauge Steel Co., Beaver Falls, Pa. The purchase gives the company seven manufacturing plants, so scattered as to cope with problems of distribution growing out of the abolition of "Pittsburgh plus." The consolidation will be effected without outside financial assistance.

Personals

C. H. ALVORD of the Hendey Machine Co., Torrington, Conn., will sail April 18 on the *Olympic* for Europe.

JOHN A. PARK will represent the Foote Bros. Gear & Machine Co., Chicago, in Mexico. His headquarters will be at the Gran Hotel, Avenida Uraquay No. 12, Mexico City.

HENRY R. BETTIS has been elected vice-president and sales manager of the newly formed Midwestern Tool Co., 5215-5225 Ravenswood Ave., Chicago, Ill. Mr. Bettis was formerly with the Illinois Tool Co. and also the Union Twist Drill Co.

LYLE MARSHALL, formerly manager of the service department of the Industrial Works, Bay City, Mich., has been appointed district sales manager with offices at 619 Dixie Terminal Building, Cincinnati, Ohio.

ROBERT R. CUTHBERTSON, manager of the Chicago office of Manning, Maxwell & Moore, New York, has resigned.

FREDERICK W. FUSSENICH has resigned as treasurer of the Hendey Machine Co., Torrington, Conn., to devote his time to his private affairs, principally to the Berkshire Mortgage & Finance Co., of which he is president. He will continue on the board of directors. His successor has not been named.

CALEB S. BRAGG has been elected a director of the Wright Aeronautical Corporation, succeeding F. B. RENTSCHLER who has resigned.

ALFRED W. LOCKWOOD has joined the sales organization of the Bridgeport Brass Co., Bridgeport, Conn., as a special representative operating out of the New York office.

JAMES E. SHEARER, assistant sales manager of the Industrial Works, Bay City, Mich., has moved his office from Bay City to 50 Church St., New York City.

T. R. LOUDON, associate professor of applied mechanics, University of Toronto, Canada, has been elected chairman of the Toronto branch of the Engineering Institute of Canada.

CHARLES L. BRADLEY and JOHN SHERWIN have been elected members of the board of directors of the Otis Steel Co., Cleveland, to succeed P. F. WILSON and J. G. CARRUTHERS, resigned. R. H. CLARK was elected vice-president to succeed D. T. CROXTON resigned. Mr. Wilson continues as second vice-president of the company. Mr. Croxton is associated with the Cleveland Cliffs Iron Co. interests.

WILLIAM T. MCNUTT and S. C. WILLIAMS and a group of Dennison business men have purchased the plant of the Dennison Foundry & Machine Co., Dennison, Ohio.

C. I. OCHS has been elected general manager of the Eaton Axle & Spring Co., succeeding J. O. EATON who has been elected chairman of the board of directors.

FRANCIS GIBBONS TATNALL has become associated with the Riehle Bros. Testing Machine Co., 1424 North Ninth St., Philadelphia, as assistant to the president.

GEORGE L. VAN MOPPES is the head of the newly formed Van Moppes Diamond Co., 200 Fifth Ave., New York City. Mr. Van Moppes was formerly connected with the firms of Van Moppes & Son, the L. M. Van Moppes Co., and the L. M. Van Moppes Diamond Co., Newark, N. J.

CHARLES E. STEPHENS has been appointed manager of the Westinghouse Electric & Manufacturing Co.'s New York office, succeeding ARTHUR E. ALLEN, who has resigned to take a position with the Westinghouse Lamp Co. Mr. Stephens has been with Westinghouse Electric since 1900.

ANNETTE ASHBURY has been admitted to membership in the British Society of Engineers. She is the first woman so honored.

K. G. FOSBERY, of the Ottawa, Ontario, staff of the General Supply Co. of Canada, Ltd., has been transferred to the Toronto office as assistant to the Toronto branch manager.

K. W. C. GRAND has been appointed acting agent general for Canada and the United States, for the Great Western Railway of England, with office in Toronto, Canada.

Business Items

The Strong, Carlisle & Hammond Co., 1392 W. Third St., Cleveland, has been appointed agent for the Oilgear Co., 655 Park St., Milwaukee, Wis.

E. S. Jackman & Co., agents for the Firth-Sterling Steel Co., have moved their Los Angeles, Calif., office from 336 East Third St. to larger quarters at 2154 Santa Fe Ave.

The Wagner Electric Corporation, St. Louis, Mo., has moved its Cleveland office and service station to 1412 East 25th Street.

The Buol Machine Co. of New Britain, Conn., has filed a preliminary certificate of incorporation at the office of the state secretary and will engage in toolmaking, machining and foundry work. The authorized capital is $100,000. The incorporators are Henry G. Schauffler of New Britain; Alfred G. Smith and Graham M. Brush, both of Greenwich. Abram Buol, formerly of the New Britain Machine Co., was the founder of the business about three years ago.

The Extruded Metals Corporation, Brooklyn, N. Y., has been chartered at Albany, N. Y., with $300,000 capital to manufacture machinery and deal in foundry and factory supplies. F. S. King, 8630 114th St., Richmond Hill, A. E. Loeffelhardt, 1195 President St., and H. B. Nash, 685 Macon St., Brooklyn, are the directors.

The Wagner Electric Corporation, St. Louis, Mo., has moved its Atlanta office and service station to 145 West Peachtree Street.

A liquidation notice of the Davis Sewing Machine Co., Dayton, Ohio, advertises the sale of more than 900 machine tools that will be sold at auction at the company's plant, April 14, 15 and 16. The assortment contains most of the standard machine tools in general use, together with special machinery, electric motors and generators and other electrical equipment.

The Clark, Wilcox Co., Inc., has filed a priliminary certificate of incorporation with the Connecticut secretary of state and will engage in the manufacture of machinery and tools in New Haven, Conn., with a capital of $50,000. F. P. Wilcox of Wolliston, Mass., and W. S. and Julia E. Clark of New Haven, are the incorporators.

The New Britain Spring Co., Inc., New Britain, Conn., has filed its preliminary certificate of incorporation in the Connecticut state secretary's office with a capital of $50 000. Charles F. and Estelle A. Robertson and Conrad O. Doran are the incorporators.

Obituaries

JAMES ARCHDALE, aged 86 years, founder and chairman of the board of directors of James Archdale & Co., Ltd., Manchester Works, Birmingham, manufacturers of radial and vertical drilling machines, died on March 22.

ARTHUR H. HORTON died at his home, 36 Hampden St., Swampscott, Mass. Mr. Horton has been an active executive of the United Shoe Machinery Co. for forty years. He was 63 years of age.

Yale & Towne Company's Promotions

The following personnel changes have been announced by the Yale & Towne Manufacturing Co., Stamford, Conn.:

W. B. Dodge has been made assistant to the president.

E. E. Erbe has been made manager of the Altoona branch.

J. R. Wilder has been made managing director of the Yale & Towne Co., London, Eng.

W. R. Hoyt has been made assistant to the vice-president in charge of production. Other changes in the sales department were also announced.

Annual Reports

The Timken Detroit Axle Co. reports a loss of $203,319 for the year ended Dec. 31, 1924, as compared with a profit of $600,881 reported in 1923.

The Wright Aeronautical Corporation reports a net income of $423,524 for the year 1924 as compared with $326,582 for 1923.

The Western Electric Co. reports total sales of $298,281,000 during the year 1924 as compared with $255,177,000 during 1923.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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EVEN in the thrilling days of the war Wall Street was not much more sensational that it was last week. On Monday May wheat sold at 1.40¼ and many stocks were below the prices at which they were quoted when the Coolidge boom started. One quite important Curb house failed, receiverships for several corporations were said to be impending and the officious *quid nunos* who are able to get a hearing at such times were predicting that the end of the financial world was near. Conditions were in fact the very converse of those that obtained early in February, when May wheat sold at $2.05 and many stocks were higher than they had been for years.

But it is to the credit of American business men that they pursued the even tenor of their way in both cases and there is reason to think that Secretary Hoover may be right in saying that the stock market is no longer barometric.

In January it was vigorously asserted that a trade revival was foreshadowed by the advance then in progress on the Stock Exchange, and last week it was just as earnestly affirmed that the decline in securities indicated the approach of an acute business contraction. Thus far neither theory has been vindicated and there is some ground for believing that the merchants and manufacturers of this country have at last learned to buy in moments of speculative depression and to refrain from buying at a time of speculative elation.

This seems almost too good to be true, but it is a fact that a seasonal improvement in distributive trade has come along as due despite the decline in stocks and grain and that merchants are operating with more confidence since the speculative bubble has been punctured.

But in the field of new construction the outlook is not quite so satisfactory and it is clear that a resumption of building activity upon the scale to which we have latterly been accustomed is not to be expected unless the cost of putting up new structures can be reduced. The railroads have also caught up with their arrears of equipment maintenance and improvements. Therefore the demand for steel, copper and lumber is less eager, prices are lower and some reduction in the output is indicated.

The reduced demand for coal, though partially seasonal, is also discouraging. The increased use of oil and hydro-electric power may be in part responsible for the depression in the coal industry, but they can hardly account for all of the reported decrease in consumption and there are many who maintain that the high cost of mining and transporting coal is the real trouble. This is certainly true of the unionized mines and many of them are shutting down because they find it impossible to compete with the non-union mines in West Virginia and Kentucky.

What's Doing in Industry

Business in the machinery and machine tool markets of the United States and Canada did not do so well in the opening week of April and dealers were at a loss to explain the sudden dearth of orders. Inquiries were about as plentiful as usual, but the month of April will probably be less active than March and about on a par with January of this year.

Buying has commenced in the automobile districts with Detroit reporting many inquiries and several important orders given. Buffalo follows with reports that automobile builders in that territory as well as accessory makers have bought tools during the past two weeks. Even Indiana reports some buying by the automotive interests.

The machinery and machine tool business placed by the railroads is far below normal with hardly any buying reported and lists fewer than usual. Some of the smaller roads of the South have placed orders for single tools.

General industrials have been reported as buying machine tools in the Eastern section of the country, but the purchases were nothing out of the ordinary.

Used tools are selling well and dealers also report that there is no trouble experienced in securing good tools. The demand for second hand presses due to delays in delivery on new presses has been reported.

Exporting is again good with Germany reported as one of the best buyers of heavy types of machines. The British automobile builders are also buying in United States markets. Other European countries reported as purchasers last week are Spain, Italy, Czechoslovakia and France.

The automobile industry has increase its rate of production since the first of the year, but it is still far from capacity and while the dealers talk hopefully there is no denying that it is very hard to sell new cars that cost more than $1,000. The purchase of the Dodge company by a firm of New York bankers is generally believed to be the first step toward the formation of a new combination that will include several important concerns.

If the consolidation is consummated the industry will be pretty well stabilized, though it is doubtful whether the effect will be to increase the sale of cars to the public. But the transaction has had a tonic effect upon the stock market and has served to offset the discouragement felt over the delay encountered in perfecting the Van Sweringen railroad merger. This delay and the smaller net earnings reported by several roads have adversely affected the market for railway shares and from being the strongest they have become the weakest group on the list.

But there has been no let up in the offerings of new bonds and an aggregate of more than $200,000,000 of such securities were advertised during the week. It is claimed that they were all sold and, although it is difficult to believe that they have all been thoroughly digested, it cannot be denied that the money derived from their sale will quicken the wheels of industry as it is spent.

This is another reason for expecting an improvement in business unless the Federal Reserve Banks raise the rediscount rate as some predict. If any such action is taken it will be resented, for the weekly statement shows a reserve ratio of 76.4 per cent and a corresponding supply of unused credit despite a reduction of $21,000,000 in the gold on hand and an increase of $46,000,000 in earning assets.

European advices say that the foreign markets are reassured by an informal announcement from the White House in which it is implied that President Coolidge approves of lending American capital abroad provided it is not used for military purposes. Great Britain is nevertheless procrastinating in arranging for a resumption of specie payment and in France the demand for further inflation has found expression in a proposal to increase the paper money outstanding from 41 billion to 46 billion francs. The Government is ostensibly opposed to this proposal, but if it should carry, a decline in the gold value of the franc would be almost unavoidable.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports gathered from the various machinery and machine tools centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Chicago

Conditions in the Chicago machine tool market continue to be favorable. The inquiries that are being received would indicate a substantial volume of business for several weeks. Railroad budgets, long awaited, are beginning to appear, and the belief prevails among machinery men that the period of comparative inactivity experienced since the first of the year has almost come to an end.

The Chicago, Burlington & Quincy R.R. has just issued an inquiry for a portion of its 1925 requirements to the extent of 40 or more machine tools. These include a 400-ton hydraulic wheel press, a 32-in. back geared crank shaper, two 54-in. wheel-boring machines, a 50-in. rotary milling machine, a 48x48 in. by 19-ft. planer, a 72-in. radial drill, one single and one double-spindle drill, three 20-in. upright drills, five high-speed hack saws, a 200-lb. hammer, seven grinders and four different sized lathes. The Atchison, Topeka & Santa Fé R.R. is inquiring for a 54-in. vertical boring machine, a 16 and 20-in. engine lathe, and a 24-in. bolt cutter.

New England

Machinery builders in the Connecticut section of the machinery area are in accord that at present business is quiet—that is, quiet as far as the inquiries are concerned, but those interviewed agree that manufacturing is going along on what they describe as "normal." The conclusion to be drawn is that business is spasmodic—showing great spurts of activity for a week or ten days and then falling off.

For a fortnight business has been quiet with builders of machinery going into the automotive industry and not one of the factory representatives could account for the condition. One of the representatives summarized the situation by attributing it to a feeling of necessity for extreme caution. Buyers in the automotive trade are requiring immediate deliveries and are placing business where they can get prompt shipment. Those concerns whose bulk of business goes directly to the automotive industry have had a good business for three months; better, in fact, that in the corresponding period a year ago.

Manufacturers whose product outlet is principally to the producers of hardware indicate that there has been a slight falling off of this business during the past quarter as compared with a year ago.

Foundrymen casting for heavy machinery report that their business is better now than it has been in the past eighteen months.

During the past week a noticable increase in the number of factory representatives was observed in different machinery centers. They were making "friendly" calls, just to get a general view of the situation, some explained.

The requests for quotations in the last ten days have been more numerous.

New York

Business in the New York machinery and machine tool markets is anything but brisk and dealers report that April opened up as quietly as March closed. There were sales made of single tools to general industrials and a few necessary tools to the railroads, but those were about all for the week.

Inquiries, however, were improved again and nearly all dealers received a number of indications that business was in the offing. But buying by the railroad that put lists out in March has not as yet been consummated and the large list issued by the Lackawanna is still a list and nothing more.

The used tool market was much better than it has been for more than a month and sales were reported by many of the dealers. The interest of these men was also directed toward the forthcoming sale of the Garvin Machine Tool Co. plant during the last of this month.

Exporters reported exceptional business for March and the first week in April. Germany is one of the best buyers of machine tools at the present time followed on the list by the British automobile makers. Spain and Italy have been in the export market to some extent also. France has not bought much lately.

Cincinnati

Manufacturers and sellers of machine tools report a decided improvement in the inquiries received, both as to the number and range of requirements, and this is taken to mean that the prospects for business are brightening. Many pending sales were closed in the last few days, some being domestic orders from Seattle and some from Washington, D. C., and other Eastern cities, while a few were for export shipment to South America.

The sale of repair parts has shown a continued improvement in the past week, which is regarded as a certain indication that conditions are getting better in the manufacturing and general business world. Practically all manufacturers and dealers express themselves as being highly pleased with the present outlook, believing that a business revival is at hand.

One dealer stated that because of the several large orders and the great number of small ones he has received, he expects to buy rather heavily, in anticipation of the greater demand he is expecting to come in the near future. The inquiries that are coming in, he stated, show that there is a real demand.

Several foreign deals have been pending for some time, and it is thought that at least some of these will be closed in the near future. The outstanding feature of the week, however, is the marked improvement of domestic orders for machinery, which range from sugar-making to steel-making equipment, these coming from widely-separated sections of the country.

Buffalo

The machine tool trade in Buffalo at the close of March was irregular. Just to show the highly spotted condition, there was one dealer who reported January and February much better from a business standpoint than March. On the other hand, another dealer of equal activity reported March much better than January and February.

Inquiries are somewhat fewer than during the first few weeks of the year, but are still keeping up sufficiently in number and variety to keep the dealers interested.

It is quite evident that there is considerable "shopping." Price seems to be the biggest factor in concluding a sale under the present conditions and those dealers whose lists are inflexible are simply out of luck.

One dealer stated that it was his belief that a "gradual increase in business should be looked for." That seems to be a rather general opinion.

There has been some activity in steam supply equipment, but it has not been of marked importance. Small tools have also had somewhat the best of it in inquiries and a few orders, despite the fact that many consumers still have heavy pre-war and war stocks so that this activity is not likely to reach the volume that some seem to expect of it.

An important tool inquiry is out in the electrical equipment line from the Hydro-Electric Commission of Canada, calling for equipment for a contemplated steam plant at or near Toronto, Ont., of 100,000 kw. capacity. This is, however, considered of comparatively little importance inasmuch as the actual erection of the plant is not definitely assured.

It is reported that there are some lines of industry in Buffalo that are natural markets for the machine tool dealers that are very busy and others that are very quiet. However, it is quite true that the automotive line is gradually picking up. This refers to automobile manufacture as well as the production of parts and accessories of which there is a large number of industries in Buffalo.

It is stated authoritatively that orders are arriving at the Pierce Arrow Motor Car Co. in greater numbers than in many months, and that this company is producing according to actual needs from thirty-five to forty cars of all types and models daily.

The Stewart Motor Corporation is also increasing its activities. It is reported that it had a very good year in 1924 from the standpoint of net returns, although its volume of business was no more than in 1923. At present it is beginning a campaign of national advertising in addition to its usual penetration through dealers. It is also planning to put out a new, specially-designed chassis for heavy-duty buses.

Most industries are described as putting on few additional workmen and at the same time, laying off few.

Detroit

Sales of machinery and machine tools in Detroit and other industrial centers of southeastern Michigan have reached the highest point so far this year. A survey of the machine tool representatives in this city indicates the reason in the steady improvement in industrial conditions in every line, with more particular reference to the speeding up of production in automobile industry.

Present requirements of the automobile factories range from small tools to large conveyors, and the market appears quite diversified. The market for used tools remains fair.

Electrical equipment is finding a much larger sale than at any previous time this year. The Detroit Edison Co. has announced plans for the erection of a new heating plant in Detroit for which considerable equipment must be purchased. The F. J. Lamb Co. has sent out an inquiry on a small list of tools.

After a long shutdown the Vassar Foundry, at Vassar, Mich., has reopened for business. The Fenton Machine Tool & Die Co. has let a contract for the construction of another factory unit in which machinery costing more than $25,000 is to be placed. The Continental Motors Corporation plant at Muskegon has recalled to work all of its old employees who had been laid off.

Work in the 28 metal working plants in Grand Rapids is reported the best in months.

For the eighth consecutive week the figures of the Employers' Association show an increase in the number of men employed in Detroit factories.

Canada

The main feature affecting the general industrial situation in Canada in the last two weeks was the presentation of the annual budget in the Federal House. Very few tariff changes were announced, the principal one being in regard to slack coal, which is now placed in the class of "coal not otherwise provided for," which means that such coal imported from the United States will be dutiable at 53 cents a ton, instead of 14 cents as in the past. It is expected this will materially aid the movement of this class of coal from the Maritime provinces to central Canada.

The duty on well-drilling machinery, apparatus and parts thereof is reduced to 5 per cent and on engines to be used exclusively in the boats of individual fishermen, to 15 per cent. The duty on rolling mill rods, which was recently removed by an order-in-council, has been restored to the former rate viz. $3.50 a ton, general tariff. The government also announced an export duty on electric energy, equal to $1.95 per hp.-year. It is expected this will tend to restrict a further flow of power to the United States and induce the location of American factories in Canada.

The rod and sheet mills of the Steel Co. of Canada are operating at full capacity, and it is reported the rolling mills have about five months' work ahead. The Montreal Locomotive Works has received orders for two Mogul locomotives for the Mond Nickel Co. and one Mikado and one 264-T Fordney locomotive for the British Empire Steel Corporation. The Canada Steamship Lines has ordered from George T. Davie & Sons, two steel freighters, to cost $500,000. What is believed to be the largest order for commercial vehicles ever placed in the Old Country by a Canadian buyer, has just been given by the British Columbia Electric Ry. Co. to the Canadian branch of the Leyland Motors, Ltd., for eight buses, each consisting of a long wheel base, medium low load line, high powered chassis.

Dillon, Read & Co. Buy Dodge Bros.

Representatives of Dillon, Read & Co. made an announcement as follows:

"An agreement has been reached for the sale of Dodge Brothers, Inc., to Dillon, Read & Co. and contracts of purchase are now being drawn.

"Consolidation of Dodge with any other company or companies is not in contemplation by the purchasers and current rumors of consolidation are entirely without foundation. It is the intention that Dodge Brothers, Inc., shall continue to be conducted as an independent corporation, without change of policy or personnel or management."

John Ballantyne, chairman of the board of directors of Dodge Brothers, Inc., confirmed the statement of sale.

The purchase price is rumored to have been $146,000,000.

Southern Metal Trades Plan Meeting

The program for the annual convention of the Southern Metal Trades Association, to be held April 28 and 29 at the St. Anthony Hotel, San Antonio, Tex., has been announced by William E. Dunn, Jr., of Atlanta, executive secretary.

A number of important addresses on technical and business subjects pertaining to foundry and machine shop practices are listed, including the following speakers: Prof. E. J. Fermier, head of the Department of Mechanical Engineering at the Texas Agricultural and Mechanical School; Charles C. Kawin, president of the Charles C. Kawin Co., Chicago; Z. G. Hopkins, manager of Public Relations for the M. K. & T. R.R.; J. N. Barnes, treasurer of the J. S. Schofield's Sons Co., Macon, Ga.; Russell Hunt, treasurer of the Sloss Sheffield Steel & Iron Co., Birmingham, Ala.; Sidney Cornelius, manager of the Open Shop Association, San Antonio; George B. Cocker, manager of the Cocker Machinery & Foundry Co., Gastonia, N. C.; J. L. Block, of Battison & Block, Houston, Tex.; C. W. Miller, service engineer with the Herman Pneumatic Machine Co., Pittsburgh, Pa.; William Oberhelman, vice-president of the Hill & Griffith Co., Birmingham, Ala.; and W. S. Mosher, president of the Mosher Steel & Machinery Co., Dallas, Tex.

Mr. Sargent's View of Associations

The new Attorney General is not expected to take up actively the matter of trade association statistics until the Supreme Court of the United States decides the cement and maple flooring cases. Since these forthcoming opinions may go far toward clearing up the uncertainty that now exists, the plan advocated by industry to bring test suits will not be pressed in the meantime.

One of the regrets expressed in connection with the selection of Mr. Stone for the Supreme Court bench was the fact that it meant the departure from the Department of Justice of an Attorney General who had given sympathetic and profound study to the whole question of trade association figures. His studies, however, may stand him in good stead in contributing to the decision of the cases now before the high tribunal and other cases that may reach it in the future.

The recent action of the Senate in calling on the Federal Trade Commission for a list of the open price associations is regarded as indicative of an increasing appreciation that there is a wide difference between that type of association and the regular form of trade association engaged entirely in work of a constructive character.

Decrease Expected in Steel Orders

Early estimates are that the U. S. Steel Corporation's unfilled tonnage statement for March will show a substantial decrease, the first in eight months.

Shipments of the corporation's subsidiaries in March were very high. Operations averaged about 94 per cent capacity and total shipments exceeded those of any month since early last year. While incoming business early in the month exceeded shipments, there was a distinct falling off in the latter half, new business in that period being only about two-thirds of deliveries.

As a result it would not be surprising if forward bookings as of April 1 should prove in the neighborhood of 5,000,000 tons, against 5,284,771 tons a month ago.

Although buying of steel is comparatively quiet, producers are encouraged by the heavy volume of specifications being issued.

Metal Trades Meet in Springfield, Mass.

The Western Massachusetts branch of the National Metal Trades Association, at its annual banquet in Springfield, March 26, was addressed by Homer D. Sayre of Chicago on conditions of the metal industry, and by Prof. Edward P. Warner of Massachusetts Institute of Technology on "Aeronautical Development Here and Abroad." These officers were elected: President, C. A. Mayer; vice-president, Harry C. Beaver; treasurer, A. D. Scott; executive committee, C. P. Russell, T. K. O'Connor, Robert E. Newcomb, S. L. Butler, C. E. Hazelton, John C. Beggs; advisory board of past presidents, George W. Kyberg, L. J. Chandler, C. E. Van Norman, George H. Empsall.

Calendar of Local Meetings

American Society of Mechanical Engineers

New York City. April 9. Local meeting of petroleum division. Subject and speaker to be announced later. Fred J. Bechert, secretary, 350 Madison Ave., New York City.

Buffalo. April 14. Local meeting. M. S. Schneider, "Material Handling." C. G. Kaelin, secretary, 635 Genesee St., Buffalo.

Milwaukee, Wis. April 15. Local meeting at the Milwaukee Athletic Club. "Co-operation between State University and Industry." Robert Cramer, secretary, 1105 Vliet St., Milwaukee, Wis.

San Francisco, Calif. April 16. Local meeting. "Engineering and Finance," Guy Emerson. F. Birdsall, secretary, the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, Calif.

Bellingham, Wash. April 17. Local meeting. "Portland Cement Grinding," Mr. Krobbe. R. L. Rockwell, secretary, 955 Empire Building, Seattle, Wash.

Salt Lake City, Utah. April 18. Local meeting. "Training of Industrial Foremen." W. H. Trask, Jr., secretary, University Club, Salt Lake City, Utah.

State College, Pa. April 18. Local meeting "Power Plants for Air Craft." Lieut. Commander E. E. Wilson; "Management," Wallace Clark. Prof. L. J. Bradford, secretary, Pennsylvania State College, State College, Pa.

Portland, Ore. June 22 to 25. Pacific Coast Regional Meeting.

Society of Automotive Engineers

Indiana Section. April 9. "Electrical Instruments for Automotive Research." J. H. Hunt.

Pennsylvania Section. April 14. "Modern Refining Processes." John D. Gill.

Detroit Section. April 16. "Sheet Metal." F. R. Pleasonton.

Metropolitan Section. April 16.

Chicago Section. April 17. "Design of the Diesel Engines." Philip L. Scott.

Cleveland Section. April 20. Production Meeting. Symposium of practices in machining connecting rods. Cleveland automobile companies.

Los Angeles Section. April 24. "Los Angeles Major Traffic Plan." David R. Faries. "Can Motor Buses Relieve Congestion?" Phil. Harris.

Washington Section. April. 24. "Around the World Flight." Lieuts. Leigh Wade and Leslie P. Arnold.

San Francisco Group. April. 30. "Six-Wheel Trucks." Ethelbert Favary.

Milwaukee Section. May 6.

Pennsylvania Section. May 12. Trip to Naval Air Station, Lakehurst, N. J., with talk by Naval officers.

Buffalo Section. May 19.

American Society for Steel Treating

Schenectady, N. Y. Spring Section Meeting. May 28, 29 and 30. Hotel Van Curler. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

National Association of Cost Accountants

Chicago Chapter. April 9. Annual Banquet. "Figuring Costs of Distribution."

Worcester Chapter. April 9. "Costs for Managerial Uses."

Philadelphia Chapter. April 10. W. H. Jackson, "Cost as an Aid to Management."

Milwaukee Chapter. April 14. W. K. Adams, "What Information Does the Bank Want."

Cleveland Chapter. April 15. "Problems of Distribution" and "Figuring the Costs of Distribution."

Rochester Chapter. April 15. M. J. Hayes, "In What Manner Do We Give Information to Foremen?" "How We Use Cost Information that is Given Us."

Syracuse Chapter. April 15. James E. Halligan, "Budgets in Franklin Management."

Buffalo Chapter. April 16. "What Information Does the Banker Want," and "Preparing Cost Data for Managerial Control."

Philadelphia Chapter. May 8. "Material Control." N. M. Cartmell.

Milwaukee Chapter. May 12, Annual election of officers.

New York Chapter. May 12. "Cost Accounting to Aid Financial Control and Forecasting." S. H. Childs.

Buffalo Chapter. May 14. Annual election of officers.

Twin Cities Chapter. May 14. A review of all previous topics of the series. Election of officers.

Cleveland Chapter. May 20. "Retailing-Reaching the Consumer," and "Uniform Costs for the Retailer."

Rochester Chapter. May 20. "Methods of Applying Selling and Administration Expenses to the Product." Prof. Charles Reitell.

Syracuse Chapter. May 20. Subject to be announced. Percy S. Brown, the speaker.

Detroit Chapter. May 21. "Experience in Simplifying the Cost System."

American Welding Society

Buffalo. April 15. S. L. Walworth, "Cutting and Welding by Carbon Arc."

Boston. April 17. Prof. V. O. Homerburg and C. E. Littlefield.

Philadelphia. April 20. S. W. Miller, "Welding Pressure Vessels."

Cleveland. April 21. Interesting welding jobs. Mr. Boom of Boom Boiler & Welding Co.

Trade Catalogs

Bar Work. The Jones & Lamson Machine Co., Springfield, Vt. A series of booklets is being issued by this firm in which various problems of machine shops are taken up and threshed out. This is Problem No. 2 and bar work is discussed in an intelligent manner. Other subjects that will be taken up in the series are the following: "Equipment," "Chucking Work," "Controlling Overhead," "Training Workers," "Designing Parts for Production," and "Threaded Work."

Manganese Steel Castings. The American Manganese Steel Co., Chicago Heights, Ill. A four-page folder has been prepared and mailed out in which the successful applications of manganese steel castings are listed. On the last page of the folder are twenty questions and answers on the question, "What Is Manganese Steel?"

Gears. The Poole Engineering & Machine Co., Baltimore, Md. Machine-molded gears are discussed in this folder and illustrations show several steps in the manufacturing process.

Grinding Wheels. The Norton Co., Worcester, Mass. A nineteen-page booklet has been prepared in which is told the story of "The Balance of Grinding Wheels." There are several half-tone illustrations and some sectional drawings.

Sine Wave Generator Sets. The General Electric Co., Schenectady, N. Y. Bulletin No. 42,567 gives a minute description of the sine wave generator and tables are printed to show the voltage under different conditions. The generator is also shown by several illustrations.

Sand Tester. The Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. This machine is designed to test the cohesiveness of molding sand. The mechanism of the machine and an explanation of how it works are given.

Testing Machines. Riehle Brothers Testing Machine Co., Philadelphia, Pa. The many virtues of the Riehle U. S. standard vertical screw power testing machines are set forth in a pamphlet recently issued. Illustrations show the parts of the machine and the machine as a unit and the text is of a convincing nature.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Portable electric hammers. Tokyo, Japan. Agency. Reference No. 14,209.

Portable gas-propelled welding lant complete with accessories. Melbourne, Australia. Purchase. Reference No. 14,306.

Bolts, nuts and screws, Amos, Quebec, Purchase. Reference No. 14,254.

Agricultural and mechanical tools. Guayaquil, Ecuador. Agency. Reference No. 14,231.

Wrecking cranes, sixty-ton. Berlin, Germany. Purchase. Reference No. 14,210.

Machine shop machinery, mining machinery, drills, chucks and machine tools. Stockholm, Sweden. Purchase and agency. Reference No. 14,296.

Portable pneumatic outfit. Melbourne, Australia. Purchase. Reference No. 14,-305.

High speed turbine lathe and electrical equipment. Melbourne, Australia. Purchase. Reference No. 14,304.

Forthcoming Meetings

American Welding Society. Annual Meeting. April 22, 23 and 24. Engineering Societies Building, 29 West 39th St., New York City.

National Metal Trades Association. Twenty-seventh annual convention. Hotel Cleveland, Cleveland, Ohio, April 22. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago, Ill.

The National Supply and Machinery Distributors' Association. Twentieth annual convention, Ambassador Hotel, Atlantic City, April 27, 28 and 29. George A. Fernley, secretary and treasurer, 505 Arch St., Philadelphia, Pa.

Southern Supply & Machinery Dealers' Assoication and the American Supply & Machinery Manufacturers Association, Joint Convention. The Atlanta-Biltmore Hotel, Atlanta, Ga., May 5, 6 and 7. F. D. Mitchell, secretary-treasurer, 1819 Broadway, New York City.

The Society of Industrial Engineers, National Convention. Hotel Winton, Cleveland, Ohio, May 6, 7 and 8. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

American Gear Manufacturers' Association. Ninth annual convention, May 6, 7 8 and 9. The William Penn Hotel, Pittsburgh, Pa. T. W. Owen secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Society of Mechanical Engineers. Spring Meeting. Milwaukee, Wis. May 18, 19, 20 and 21. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Division V of the American Railway Association. Business meeting June 16 to 18, Chicago. V. R. Hawthorne, 431 S. Dearborn St., Chicago, Ill.

Society of Automotive Engineers. Summer Meeting. Greenbrier Hotel, White Sulphur Springs, W. Va., June 16, 17, 18 and 19. C. F. Clarkson, secretary, 29 West 39th St., New York City.

American Society for Testing Materials. Twenty-eighth annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 22, 23, 24, 25 and 26. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

National Foreign Trade Council. Annual Convention. Seattle, Wash., June 24, 25 and 26. O. K. Davis, secretary, India House, Hanover Square, New York City.

New Haven Branch of the American Society of Mechanical Engineers. Fifth annual machine tool exhibition. Sept. 8 to 11. Mason Laboratory. H. R. Westcott, chairman.

American Society for Steel Treating. Annual Convention and National Steel Exposition. Public Auditorium, Cleveland, Ohio. Week of Sept. 14. W. H. Eisenman, Secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Iron prices firm at present levels despite slowness of buying; less competition from foreign makers in present market. Semi-finished steel weak. Steel sheets least firm of all steel items. Mill price of steel bars now $2.10@$2.20 per 100 lb., f.o.b. Pittsburgh; that of plates and shapes, $2@$2.10 per 100 lb. The trend is downward in steel products.

Non-Ferrous Metals—All products in this class are considerably under the Mar. 26 levels. Tin is at the lowest point reached thus far this year and is cheaper than at any time since the week of Oct. 23, 1924.

Linseed Oil—Price is down 5 to 8c. per gal. from Mar. 26 level.

(All prices as of April 3)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$26.05
Northern Basic	23.77
Southern Ohio No. 2	23.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	32.25
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.76
Virginia No. 2	30.17
Basic	24.76
Grey Forge	23.75
CHICAGO	
No. 2 Foundry local	22.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	28.01
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	23.77
Basic	23.77
Bessemer	23.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.70	3.89	3.45	3.80
No. 12	2.80	3.94	3.50	3.85
No. 14	2.90	3.99	3.55	3.95
No. 16	3.10	4.09	3.65	4.15
Black				
Nos. 17 and 21	3.35@3.45	4.55	4.15	4.30
Nos. 22 and 24	3.40@3.50	4.60	4.20	4.35
Nos. 25 and 26	3.45@3.55	4.65	4.25	4.40
No. 28	3.50@3.60	4.75	4.35	4.50
Galvanized				
Nos. 10 and 11	3.65@3.75	4.75	....	4.50
Nos. 12 and 14	3.75@3.85	4.85	....	4.60
No. 16	3.90@4.00	5.00	....	....
Nos. 17 and 21	4.05@4.15	5.15	....	4.90
Nos. 22 and 24	4.20@4.30	5.30	3.00	5.05
No. 26	4.35@4.45	5.45	4.15	5.20
No. 28	4.65@4.75	5.75	5.45	5.50

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	59½%	48%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	56½%	45%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ⅛-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
⅛	$0.09	50%	⅞	$0.16	35%
¼	.11	45%	1	.18	31%
⅜	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.85	8.00	7.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	7.00	8.25	7.85
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	4.00	3.80
Cold drawn flats, squares	4.65	4.50	4.30
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00@3.10 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. Chicago, 3/32, 8.85c.; 5/32, 7¾c.; ⅛, 7.95c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.87½
Tin, 5-ton lots, New York			52.25
Lead (up to carlots), St. Louis	8.00	New York	8.87½
Zinc (up to carlots), St. Louis	7.07½	New York	7.87½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	14.75	17.75	....
Copper sheets, base	22.00	21.75	22.12½
Copper wire, base	19.87½	21.25	20.75
Copper bars, base	21.12½	21.50	22.62½
Copper tubing, base	24.00	24.25	25.75
Brass sheets, base	18.37½	18.62½	19.25
Brass tubing, base	23.00	25.25	25.00
Brass rods, base	16.12½	16.37½	18.37½
Brass wire, base	18.87½	20.12½	20.25

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1–15 ton lots	27.20	28.00	27.00
Zinc sheets (casks)	11.00	11.50	11.37
Solder (½ and ½), (case lots)	38.00	37.00	.....
Babbitt metal (83% tin)	60.00	63.00	50.00
Babbitt metal (35% tin)	28.00	20.50	28.00
Nickel (ingots) f.o.b. refinery	29.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	33.00	.....	.....
Nickel (F shot) f.o.b. refinery	30.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.00@11.50	11.25	11.25
Copper, heavy, and wire	10.75@11.25	11.00	11.00
Copper, light, and bottoms	9.50@10.00	9.00	9.00@9.75
Heavy lead	6.50@6.75	6.50	6.50@6.62½
Tea lead	5.50@5.75	4.00	4.00@5.62½
Brass, heavy, yellow	6.75@7.25	7.00	7.00
Brass, heavy, red	8.50@8.75	9.00	8.62½@9.00
Brass, light	6.00@6.25	5.50	5.50@6.12½
No. 1 yellow rod turnings	7.25@7.50	7.00	7.00@7.37½
Zinc	4.25@4.50	3.75	3.75@4.37½

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$23.50	$22.85	$21.00
"A" Grade:				
IC,	20x28, 112 sheets	19.00	18.80	17.00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	13.00	12.20	13.00
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.25	6.80@6.90	6.75

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.14@0.16
Cotton waste, colored, per lb.	.10@.15½	.18	.09½@.12½
Wiping cloths, 13¼x13¼, per lb	.09¼@.09¾	36.00 per M	.11
Wiping cloths, 13¼x20½, per lb.	.....	50.00 per M	.11
Sal soda, per 100 lb. keg	2.25	2.25	2.25
Roll sulphur, per 100 lb. keg	3.60	3.25	3.75
Linseed oil, per gal., 5 bbl. lots	1.09	1.24	1.25
Lard cutting oil, 25% lard, per gal.	.60	.50	.32
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.33	.35	.21
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–2½%	30–10%	40–2½%
Heavy grade	30–5%	30%	38–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50–5%	50–10%	60%
Second grade	50–10–5%	60–5%	65%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0354
Cold finished shafting	per lb.	.0415	.0415	.044
Brass rods	per lb	.1612½	.1762½	.155
Solder (½ and ½)	per lb.	.38	.42	.3675
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.38
Lard cutting oil	per gal.	.60	.60	.58
Machine oil	per gal.	.33	.33	.29
Belting, leather, medium	off list	40–2½%	40–2½%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$4.86	$5.84	.....
Emery paper	10.71	11.00	$11.90
Emery cloth	28.00	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.24	1.65
Cloth	3.38	2.67	3.55
Fire clay, per 100 lb. bag	.....	.65	.75
Coke, prompt furnace, Connellsville	per net ton	3.50@3.75	
Coke, prompt foundry, Connellsville	per net ton	4.25@4.75	
White lead, dry or in oil	100 lb. kegs	New York, 16.25	
Red lead, dry	100 lb. kegs	New York, 16.25	
Red lead, in oil	100 lb. kegs	New York, 17.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1½ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%. Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.50 per 100 lb. at Cleveland.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses; with hex. heads, $4.65 per 100 lb. net at Chicago.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in. and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ¼-in., ⅜-in., 1-in. diam. x 2$\frac{1}{16}$-in. to 4$\frac{1}{16}$-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c., longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk, heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ill., Chicago — G. B. Ackerman, 1516 North Menard Ave., G. B. Ackerman, Pur. Agt.—additional equipment for sheet metal and tinsmith shop.

Ill., Chicago—Apex Products Co., 3243 West 30th St. (manufacturers of laundry equipment), J. F. Cervenka, Pur. Agt.—machines, tools, etc., for the manufacture of washers, etc.

Ill., Chicago—Atchison, Topeka & Santa Fe R.R., Railway Exchange Bldg., M. J. Collins, Pur. Agt.—11 machine tools including planers, bolt cutters, boring mills, box presses, etc.

Ill., Chicago—W. H. Barber Co., 3650 South Homan Ave. (manufacturers of marine equipment)—additional machinery for new factory unit.

Ill., Chicago — Chicago, Burlington & Quincy R.R., 547 West Jackson Blvd., L. N. Hopkins, Pur. Agt.—42 machine tools, including radial, drills, lathes, boring machines, pipe threading machines, cylinder grinders, etc. Also 10 ton gantry crane, for delivery at Aurora, Ill., storehouse.

Ill., Chicago — O. K. Colby, 1639 East 79th St., O. K. Colby, Pur. Agt.—additional equipment for new machine shop.

Ill., Chicago—The Glass Novelty Co., 1915 West 19th St., A. G. Feldman, Pur. Agt.—(baby beds and cribs) woodworking machinery for new factory.

Ill., Chicago—Holmquist Tire & Vulcanizing Co., 6712 South Ashland Ave. A. Holmquist, Pur. Agt.—new vulcanizing machinery, additional small tools and general garage equipment.

Ill., Chicago—F. Karl, 4228 West 16th St.—Complete equipment and repair tools for garage and repair shop.

Ill., Chicago—Locomobile Co. of Illinois, c/o M. S. Nelson, 1722 North California Ave., Archt.—garage equipment and repair tools, for service station, at 2400 Michigan Ave.

Ill., Chicago—Wilbert Garage, 408-14 West Homan Ave., M. Wilbert, Pur. Agt.—complete equipment and tools for repair shop.

Ill., Chicago—H. Wolfson, 2241 South State St., equipment and tools for auto wagon repair shop.

Ill., Harvey — Pettigrew Foundry Co., 146th and Lincoln Sts., M. Service, Pur. Agt.—lathes, 4 ft. gap.

Ky., Louisville—Louisville Tin & Store Co. — 6 ft. brake, preferably Robinson (used).

Mass., Beverly—H. H. Whitman, Grove St.—equipment and tools for repair garage, at Grove St., North Beverly.

Mass., Boston—Albany Milling Co., 11 Bristol St.—horizontal borer with sliding spindle.

Mass., Brighton (Boston P. O.)—Joseph Waldman, 38 Hobson St.—miscellaneous tools and equipment for large repair and service garage, on Livingston St., Dorchester.

Mass., Everett—Market Forge Co., Garvey St. and Boulevard—surface grinder, with magnetic clutch, suitable for grinding dies

Mass., Great Barrington—J. T. Harper, Main St.—equipment and tools for service garage at Main and Bridge Sts.

Mass., Marlboro—School Building Committee—equipment for manual training department of new high school, including metal working machinery.

Mass., Salem—Wetmore & Simons, 118 Washington St.—tools and equipment for repair garage.

Mass., Somerville—A. Davis, 14 Cross St.—miscellaneous tools and equipment for large repair and service garage on Madison St.

Mass., Rockport—School Bldg. Committee—manual training equipment for new high school, including woodworking machinery.

Mass., Worcester—Chiz and Jackson, 22 Rockwood St.—tools for repair and service station, on Quinsigamond Ave.

Minn., St. Paul—Northern Pacific R.R., Railway Bldg., R. J. Elliott, Pur. Agt.—48 in. car wheel borer; No. 12 Atkins quick cut saw; No. 5 Oliver drill pointer; arbor and straightening press.

Mo., Centerville—Reed Lumber Co.—equipment including fast feed planing machine, lumber buggies, etc. (new or used).

N. Y., New York—Quality Art Novelty Co., 18 West 18th St.—universal miller, J. Thompson style 5 C or 6 C.

N. Y., New York—Stabilated Spring Co., 2241 Fifth Ave.—arbor press with forge and anvil.

O., Cleveland—J. G. Hawkey, 734 Penton Bldg.—one 16 ft. x 20 in. shaper; 4 ft. radial drill, Cincinnati preferred; 14 in. x 6 ft. lathe, double end and centering machine, 48 in. between centers.

Okla., Okmulgee—Auto Machine Shop, 104 West 4th St., L. L. Richards, Pur. Agt.—1 Lodge & Shepley, American or Hendy lathe, 14 or 16 in.; 1 punch press, to punch holes in webb and side 6 in. angle iron (used).

Okla, Sapulpa—Ideal Machine Co., 501 East Dewey St.—30 to 36 in. lathe, with 14 ft. bed. Preferably Lodge & Shipley, Hendy or American lathe (used).

Pa., Johnstown—Bd. of Education—lathes, and other shop equipment for vocational departments.

Pa., Union City—Lee & Watts—lathe, drill press, cylinder reboring machine.

W. Va., Charlestown—Bd. of Education—equipment for vocational departments of new schools.

Wis., Janesville—Bower City Millwork Co., 316 Wall St.—additional woodworking machinery.

Wis., Milwaukee—H. D. Rhoda, 594, 34th St.—metal working lathe.

Wis., Racine—Standard Foundry Co., 1600 Kewaunee St.—foundry equipment including electric traveling crane with 80 ft. span.

Wis., Wauwatosa—Goebel & Oberle, 66 Vine St.—sheet metal working machinery for new shop.

Ont., Ottawa—Capital Wire Cloth Mfg. Co. Ltd., 24 Huiton Ave.—J. W. Perazzo, Secy.—machinery for the manufacture of wire cloth.

Que., Quebec City—Bergeronnes Lumber Co., Ltd., M. H. Kaine, Pur. Agt.—complete equipment for new saw and shingle mills.

Opportunities for Future Business

Ark., Texarkana—Graysonia, Nashville & Ashdown R.R., G. T. Conway, Pur. Agt. plans to rebuild shops, destroyed by fire. Estimated cost $150,000.

Calif., Crescent City — State Highway Commission, Forum Bldg., Sacramento, plans the construction of a garage and maintenance equipment shop here. Estimated cost $40,000. R. M. Morton, Forum Bldg., Sacramento, State Highway, Engr.

Calif., San Francisco — American La France Engine Co., 151 New Montgomery St. plans the construction of an assembly plant and repair shop at 16th and Shotwell St. Estimated cost $40,000.

Calif., Santa Cruz — County of Santa Cruz, H. E. Miller, Clk. is having plans prepared for the construction of a garage and machine shop. Estimated cost $5,000. L. Bowman, County Surveyor, Engr.

Ill., Chicago—Locomobile Co. of Illinois, c/o M. S. Nelson, 1722 North California Ave., Archt. is having plans prepared for the construction of a 2 story, 100 x 161 ft. service station, and sales building, at 2400 Michigan Ave. Estimated cost $200,000.

Md., Baltimore—Masson's Express, 107 West Pratt St., G. F. Masson, Pres., awarded contract for the construction of a 3 story, 90 x 140 ft. garage and warehouse, at Pratt & Poppleton Sts. Estimated cost $150,000. Noted Feb. 19.

Mass., Brookline (Boston P. O.)—G. W. Bunnell, 56 Winchester St., awarded contract for the construction of a 4 story, 70 x 245 ft. garage, at 565-589 Newbury St. Estimated cost $200,000. Noted Jan. 22.

Mass., Lee—White Marble & Terazzo Co., J. F. & M. Deely, plans the construction of a plant including machine shop, to replace recent fire loss. Estimated cost $75,000. Architect not selected.

Mich., Detroit—Postal Station Building Co., 341 Postal Station Bldg., R. D. Brown, Pres., is having preliminary plans prepared for the construction of a 2 story post office garage. Estimated cost $200,000. Bass-Knowlton & Co., Indianapolis, Ind., Archts.

Minn., St. Paul—Tri-State Telephone and Telegraph Co., 369 Ceder St., awarded contract for the construction of a 3 story warehouse and garage, on 10th St. between Roberts and Minnesota Sts. $150,000. Noted Mar. 19.

O., Cleveland—Bryant Heater & Mfg. Co. 952 East 72nd St., O. Fox, V.-Pres., awarded contract for the construction of a 150 x 300 ft. factory and a 35 x 90 ft. office building on East 179th St. Estimated cost $125,000. Noted Mar. 12.

O., Cleveland—Kline Spring Co., c/o A. B. Kline, Pres., Babbitt Rd. and New York Central R.R. awarded contract for the construction of a 50 x 100 ft. factory at 19100 Firewood Ave. Estimated cost $40,000.

O., Cleveland—Star Machine & Tool Co., Carnegie Ave., J. J. Schuger, Pres., will soon award contract for the construction of a 93 x 100 ft. machine shop on East 93rd St. Estimated cost $40,000. Private plans.

Pa., Brackenridge—Allegheny Steel Co., plans the construction of a 76 x 96 ft. foundry. Estimated cost $4,000. Private plans.

Wis., Janesville—Chamber of Commerce, 144 East Milwaukee Ave., awarded contract for the construction of a 158 x 200 ft. manufacturing building. Estimated cost $60,000. Northern Conveyor & Mfg. Co., 3204 Aure Ave., Milwaukee, is lessee.

Wis., Milwaukee—Seaman Body Corp., 1732 Richards St., awarded contract for the construction of a 5 story, 100 x 400 ft. factory, on Richards Ave. Noted Feb. 19.

B. C., Westminster—K & L Box & Lumber Co., Niles, Calif., will soon award contract for the construction of a box factory, 80,000 boxes, daily capacity, on the north arm of the Fraser River. Estimated cost $100,000.

Ont., Goderich—Dominion Road Machinery Co., T. H. Mitchell, Mgr., plans the construction of factory addition. Estimated cost $25,000.

Ont., Holland Center—R. F. Harber plans the construction of saw mill to replace fire loss.

Ont., Mitchell—Wettlaufer Bros. Ltd., is having plans prepared for the construction of a 100 x 462 ft. factory and 70 x 140 ft. foundry. Estimated cost $100,000.

Que., Grande Mere—Dominion Electric Heating Co., 140 Anchers St., Montreal, plans the construction of a 2 story, 100 x 100 ft. manufacturing plant, here. Estimated cost $75,000.

Que., Grand Mere—Fairchild Aerial Surveys of Canada, Ltd., plans the construction of a manufacturing plant, here. Estimated cost $150,000.